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United States Patent [19]

Byrne

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[54] **MODULAR GLAZING SYSTEM**

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[21] Appl. No.: **621,599**

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[51] **Int. Cl.**[6] **E06B 3/62**

[52] **U.S. Cl.** **52/204.5**; 52/204.591; 52/204.597; 52/656.9; 52/656.1

[58] **Field of Search** 52/729.1, 734.2, 52/204.591, 204.595, 204.597, 204.62, 204.7, 204.57, 204.58, 656.1, 656.9

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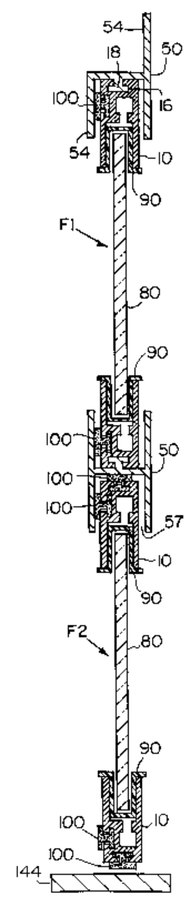
Primary Examiner—Wynn E. Wood
Attorney, Agent, or Firm—Iandiorio & Teska

[57] **ABSTRACT**

A modular glazing system having several members, each member having one or more keyways or keys that permit the members to be connected. A preferred embodiment has four fundamental shapes: a base longitudinal member, an expander A, an expander B and a screen sash member. The base longitudinal member has a glazing channel, through which supplemental or primary glazing material is inserted. Along one side wall of the base longitudinal member is a keyway formed to interlock with a key from another piece. At right angles to the first keyway in the base longitudinal member, and disposed along a bottom wall of the base longitudinal member is another keyway, similarly shaped. The base longitudinal member also has an interior aperture through which an L-shaped connector is inserted to form corners. An expander A, shaped generally like the letter H, has two keys, one located on either side of the middle bar of the "letter" H. An expander B has only one key, depending downwardly from the middle bar of the "letter" H. Each expander can be further modified by removing one or more of the walls of the letter H or bending them, as may be required. Glazing material is inserted into base longitudinal members joined by connectors. A resilient material is inserted into the keyways that form the outer edges of each of these base longitudinal members, allowing the unit formed to be compression fit into a window opening. Expanders allow several units to be joined.

5 Claims, 15 Drawing Sheets



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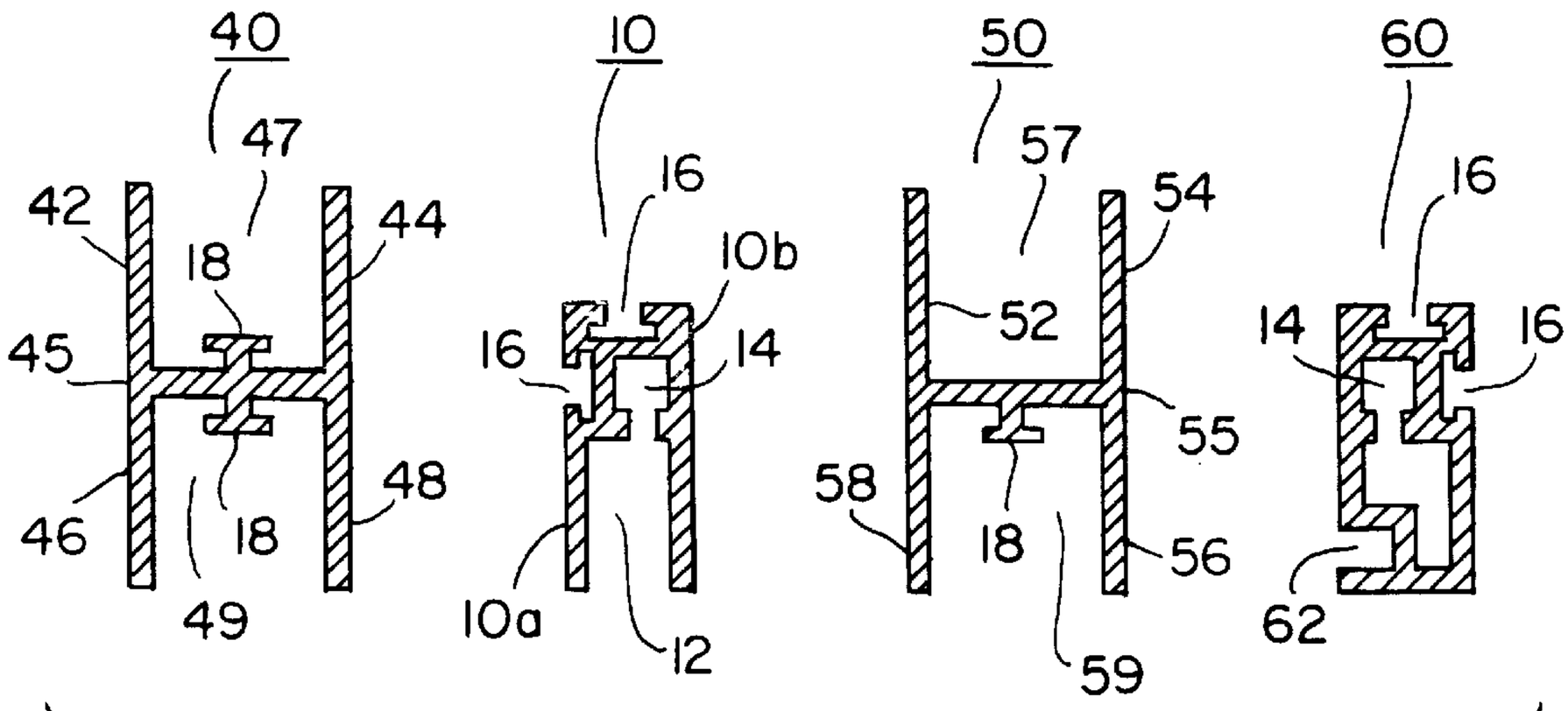


FIG. 1A

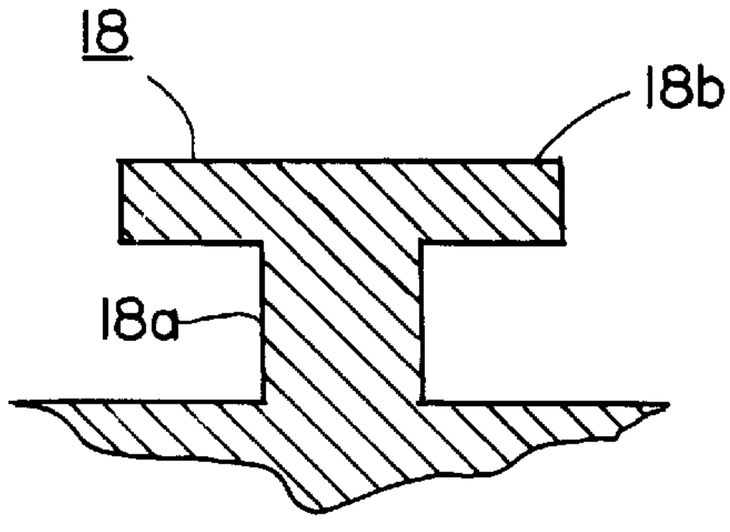


FIG. 1B

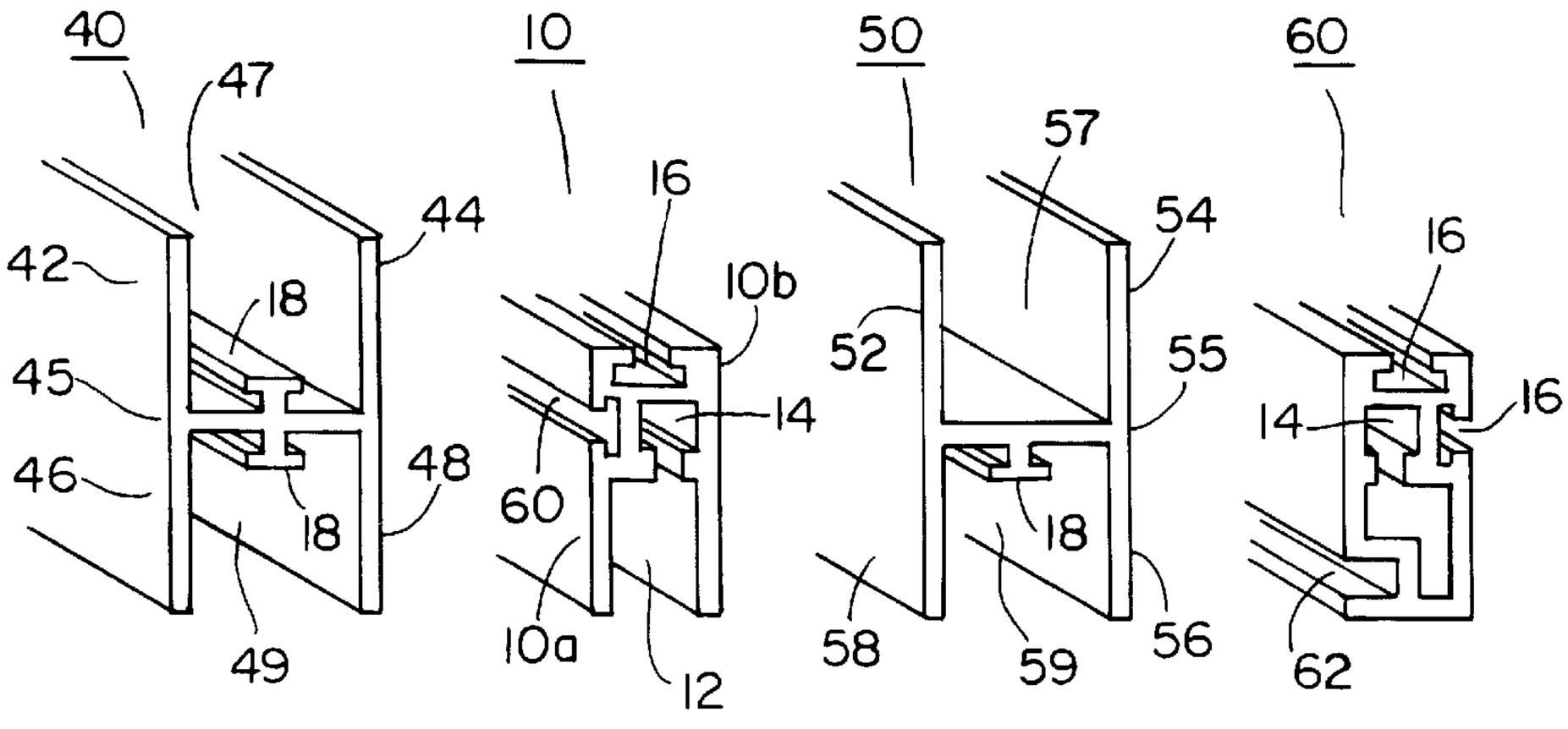
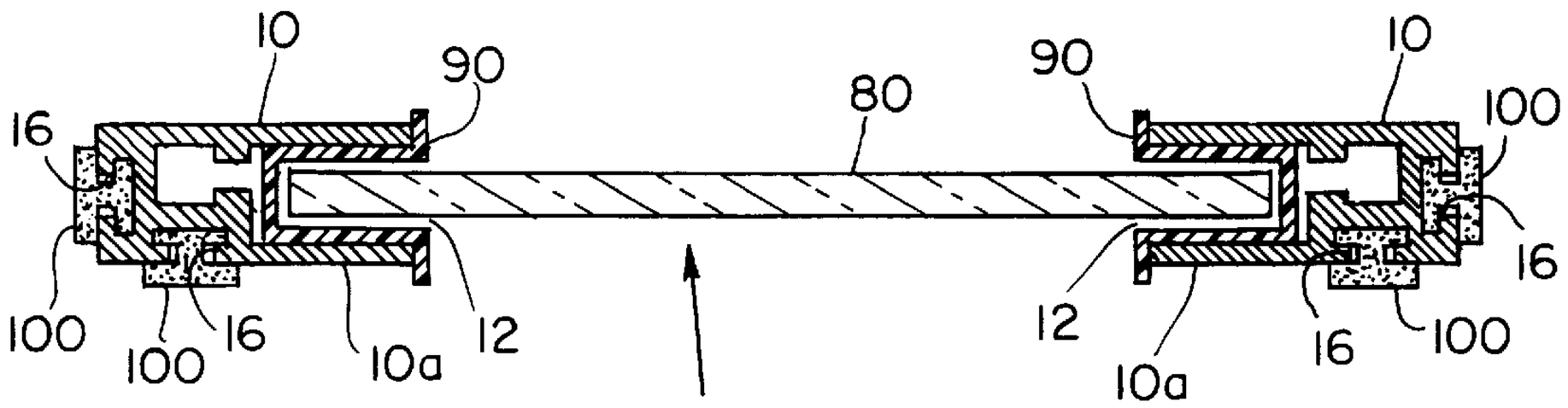


FIG. 2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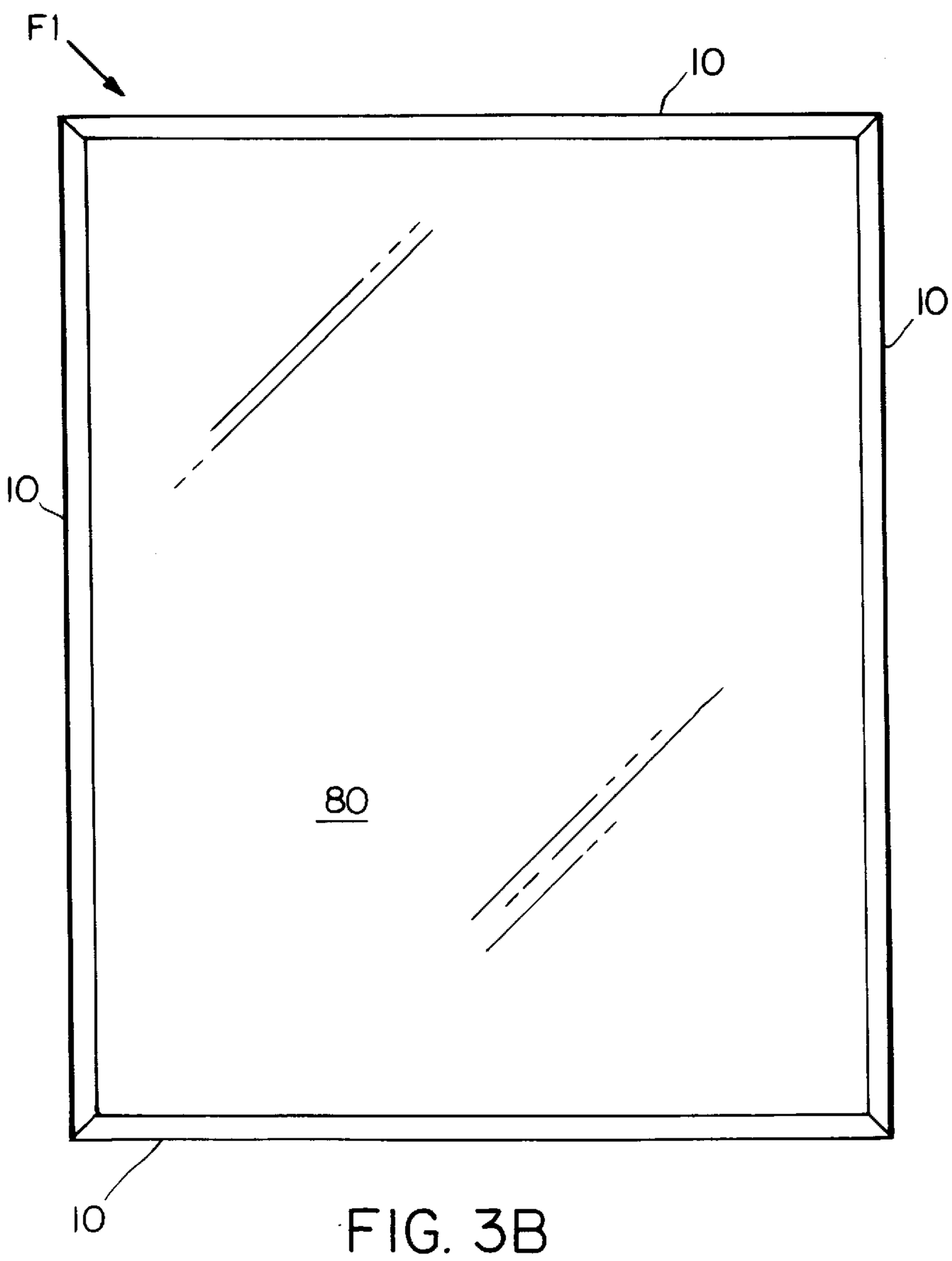
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FIG. 3B

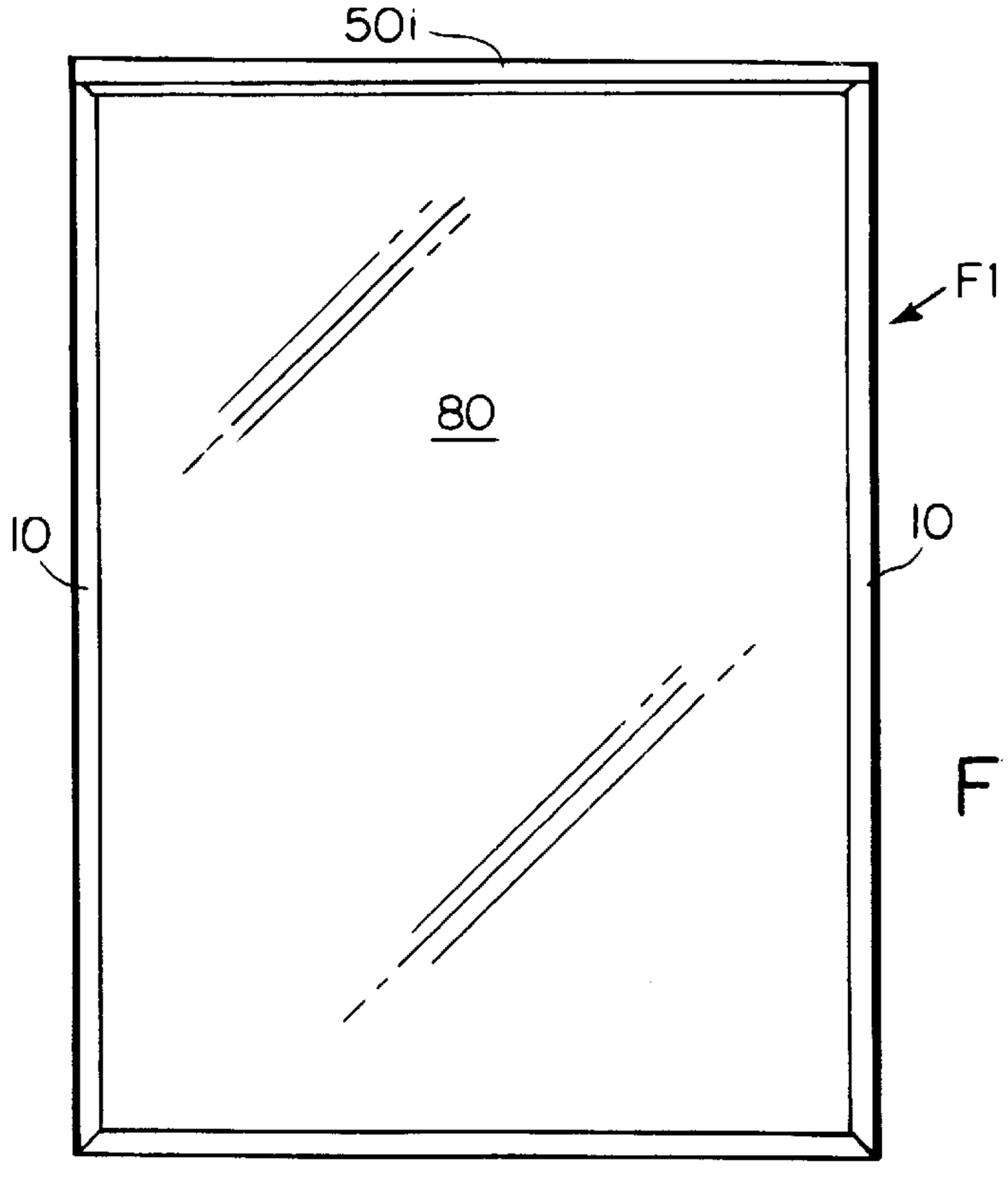

FIG. 4B

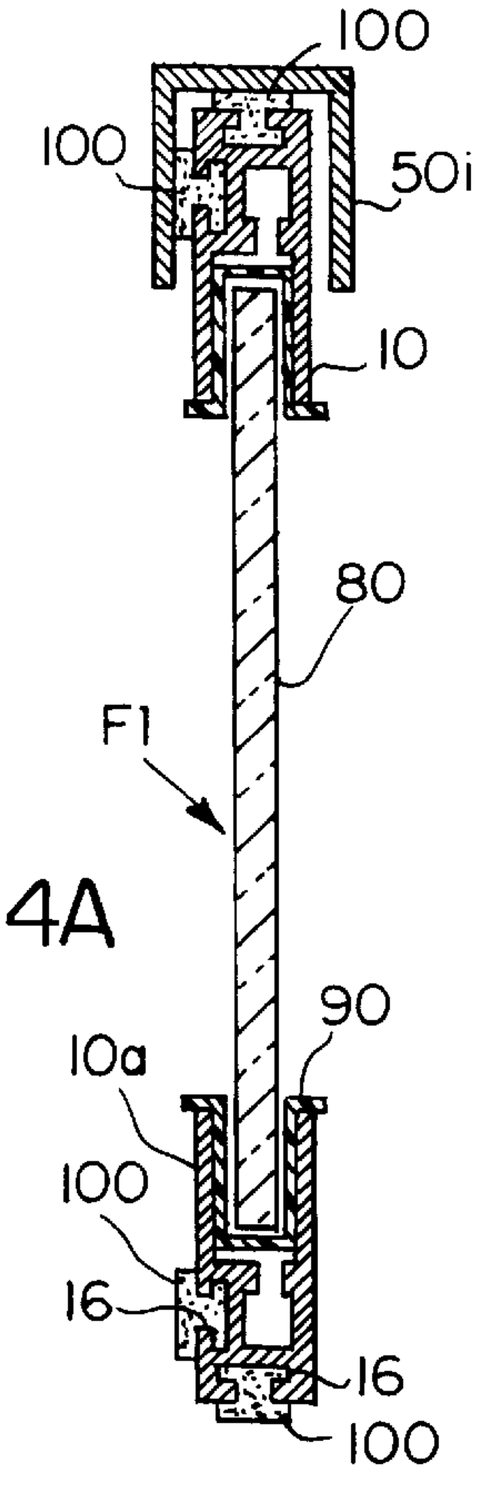

FIG. 4A

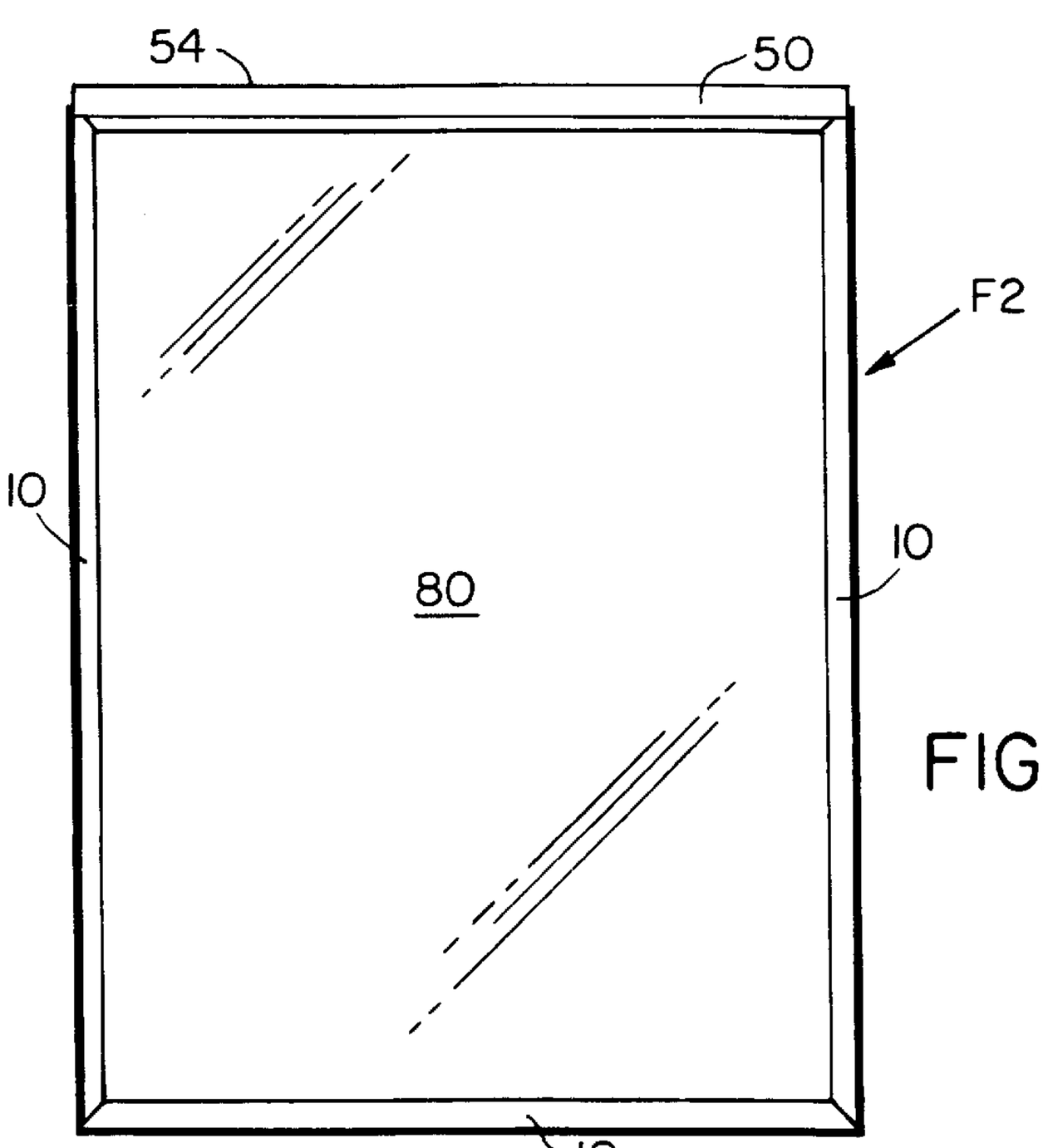

FIG. 4D

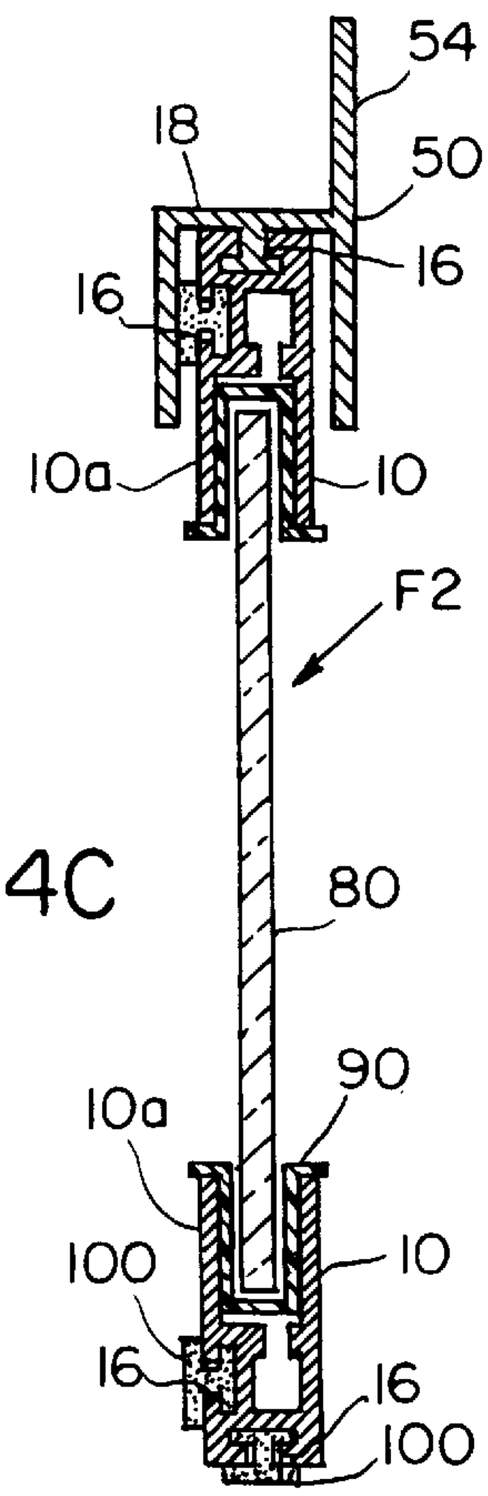

FIG. 4C

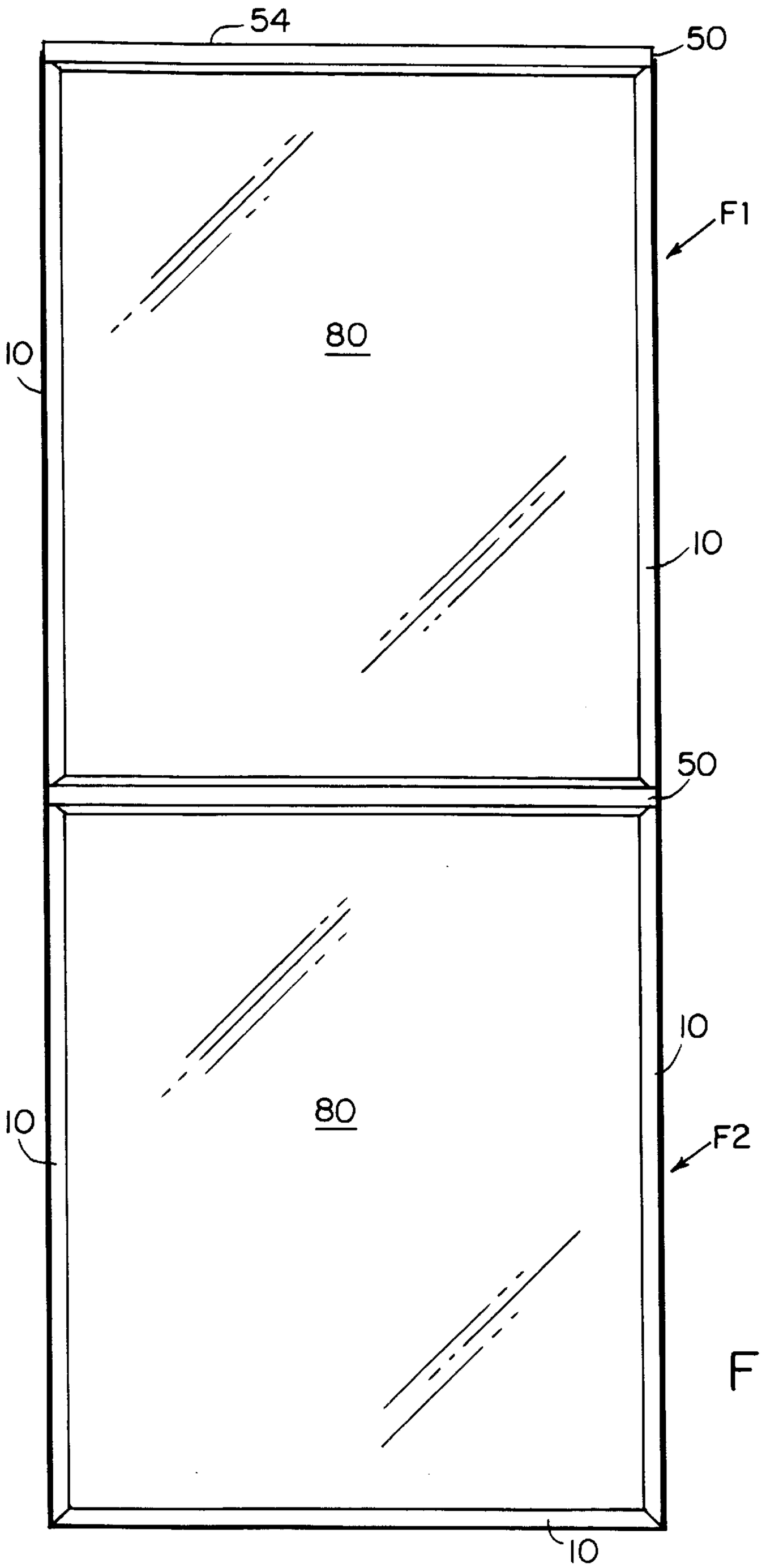
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FIG. 5B

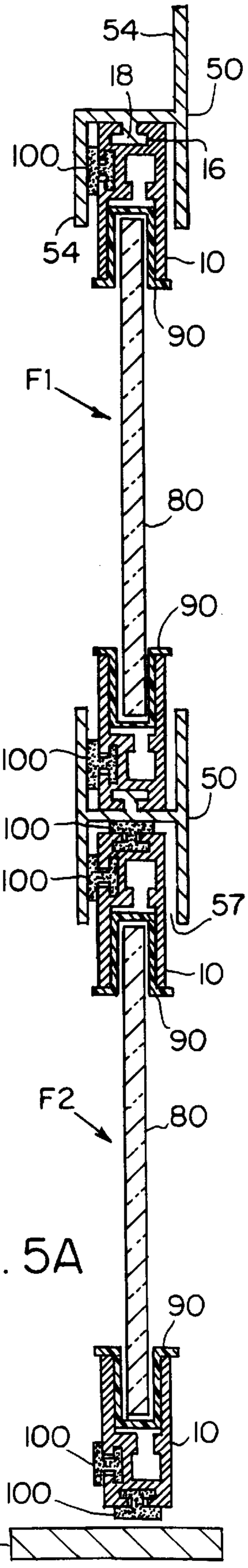
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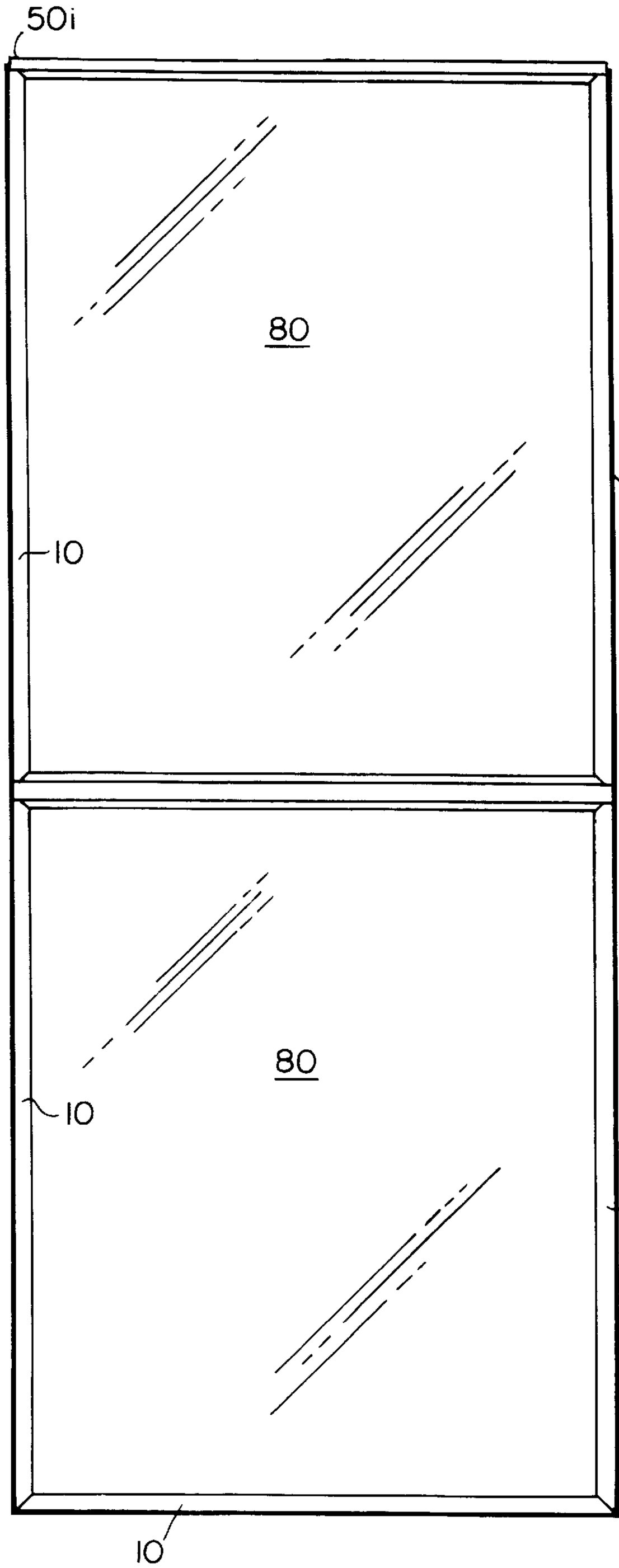
FIG. 5A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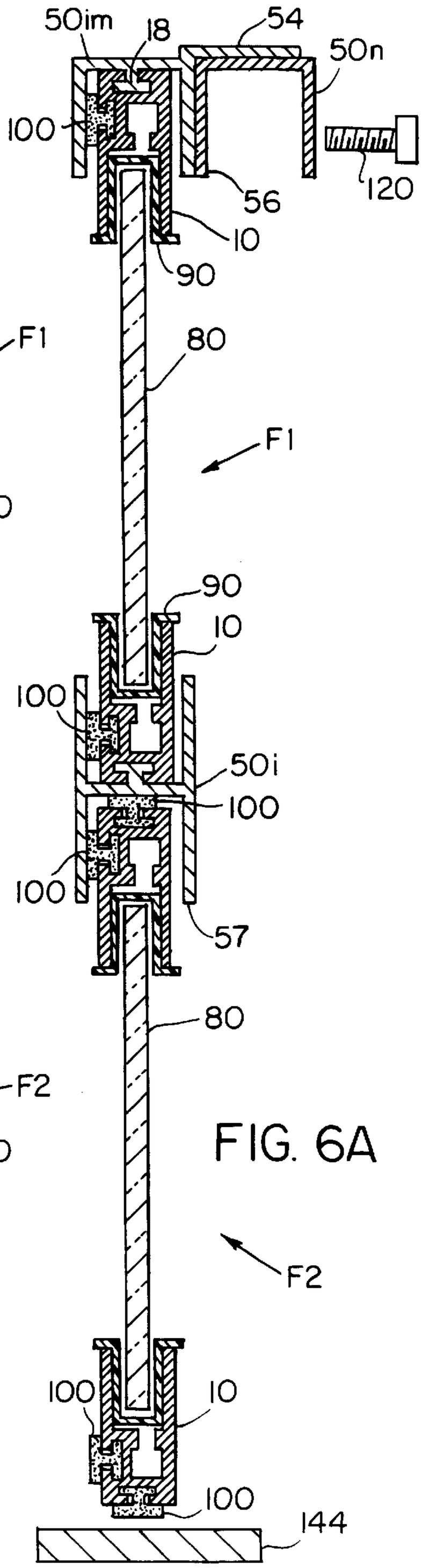
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FIG. 6A

FIG. 6B

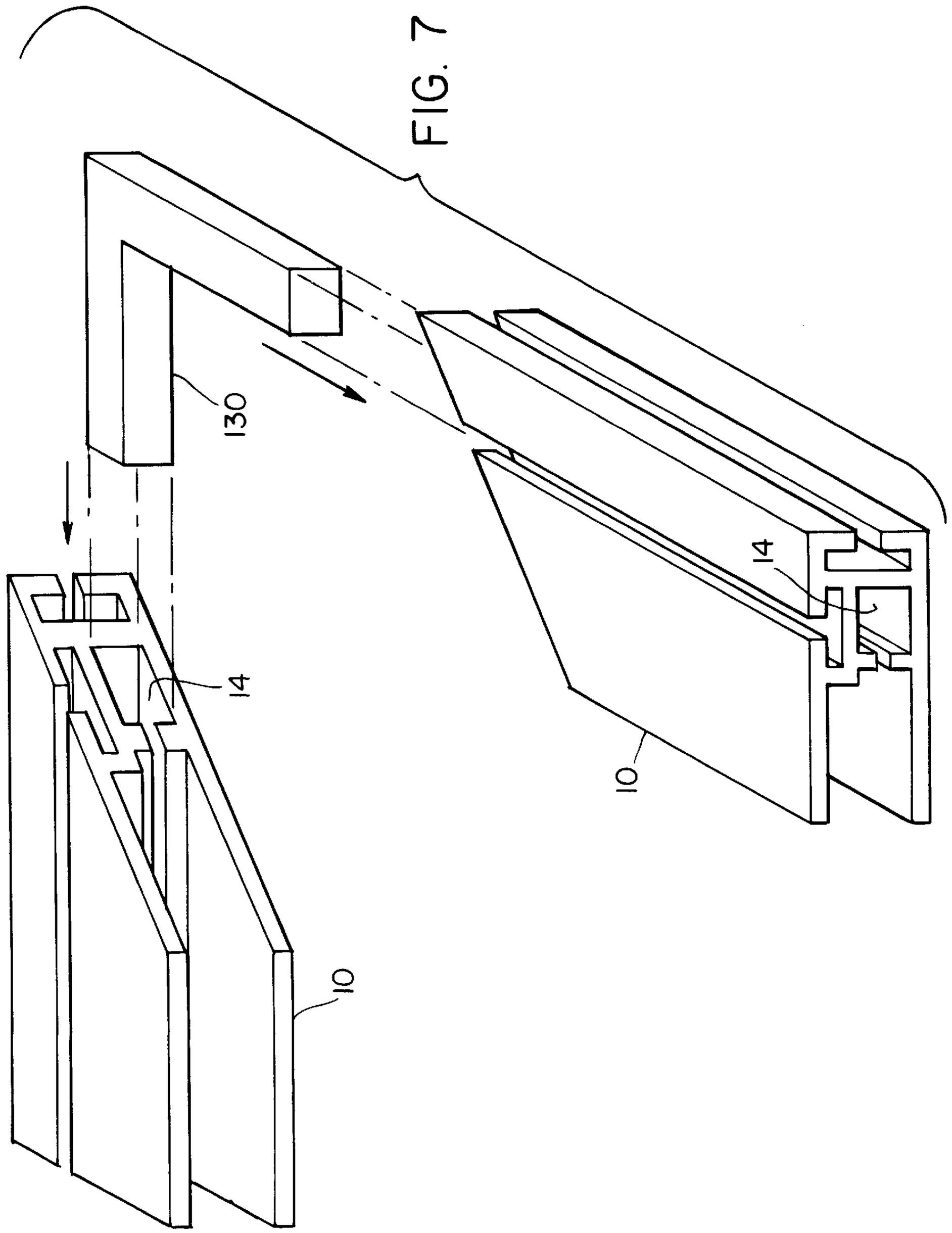

FIG. 7

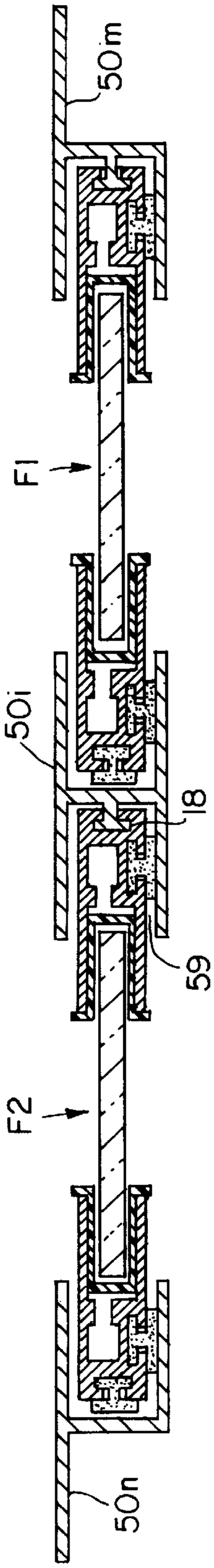

FIG. 8A

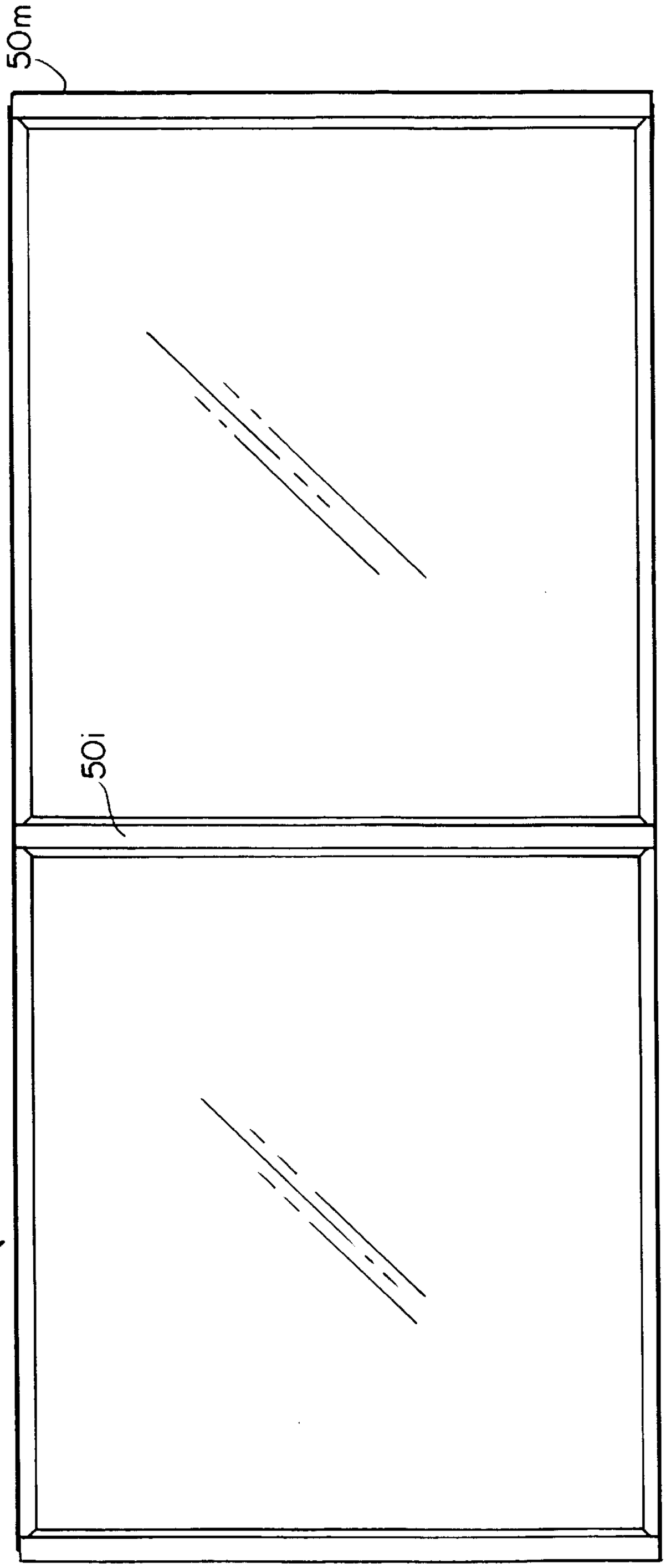

FIG. 8B

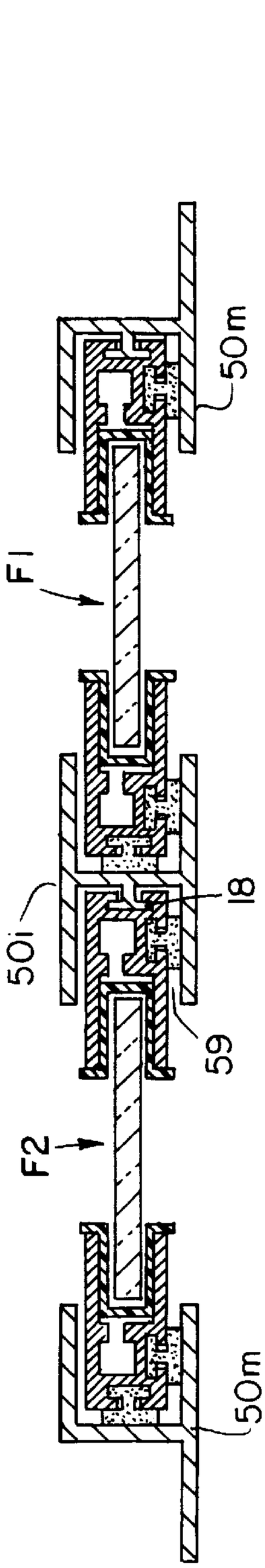

FIG. 9B

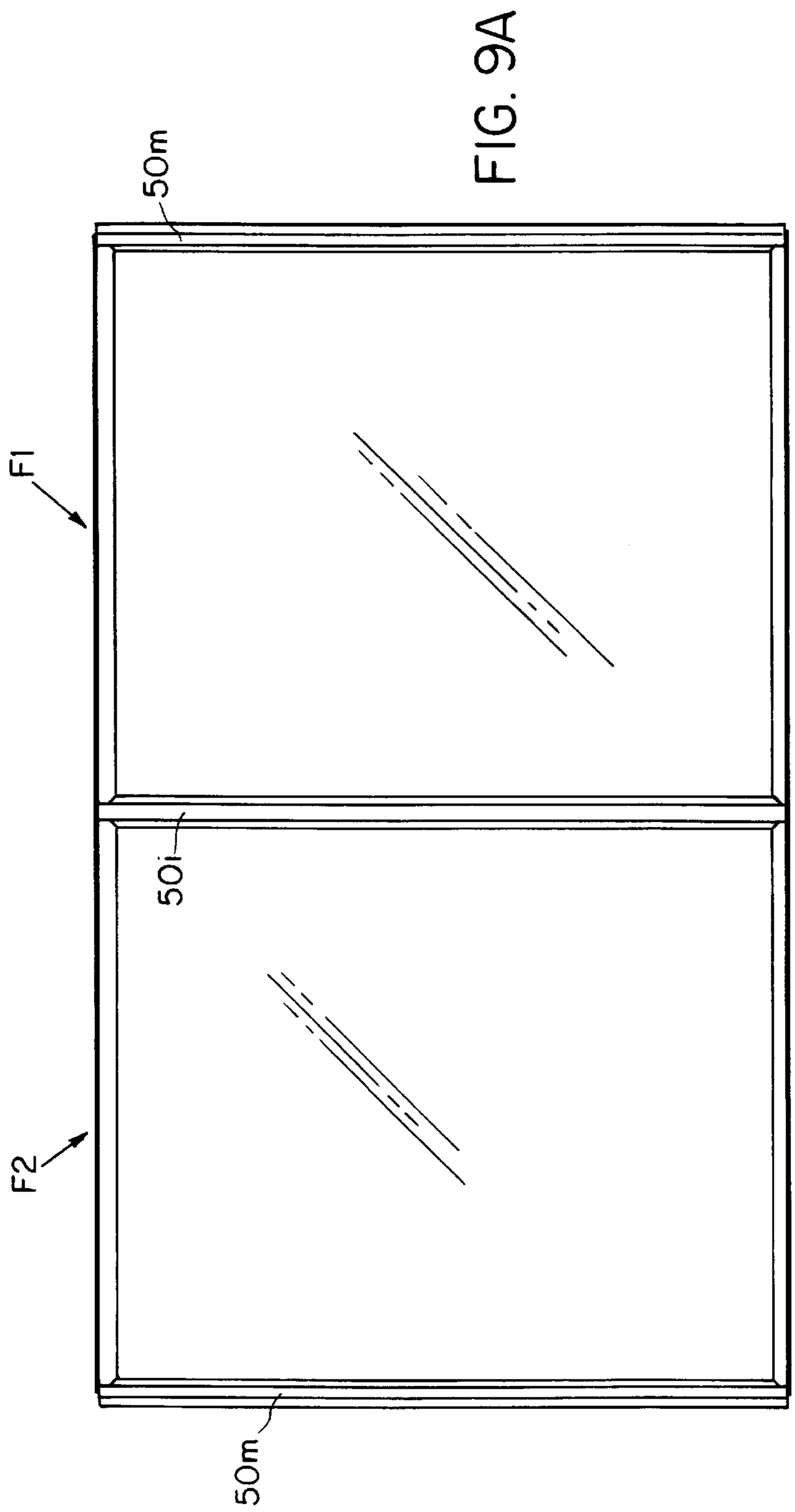

FIG. 9A

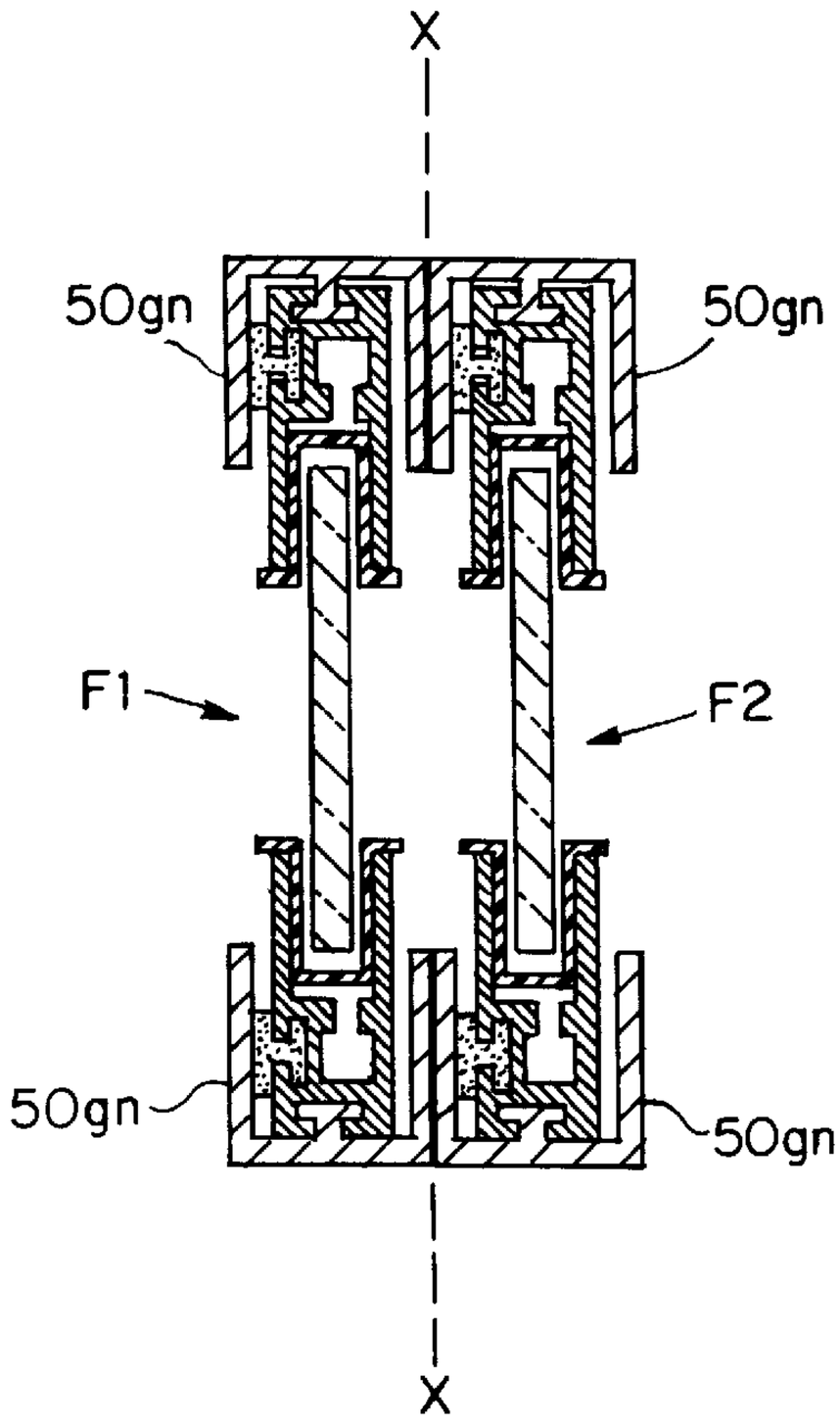

FIG. 10A

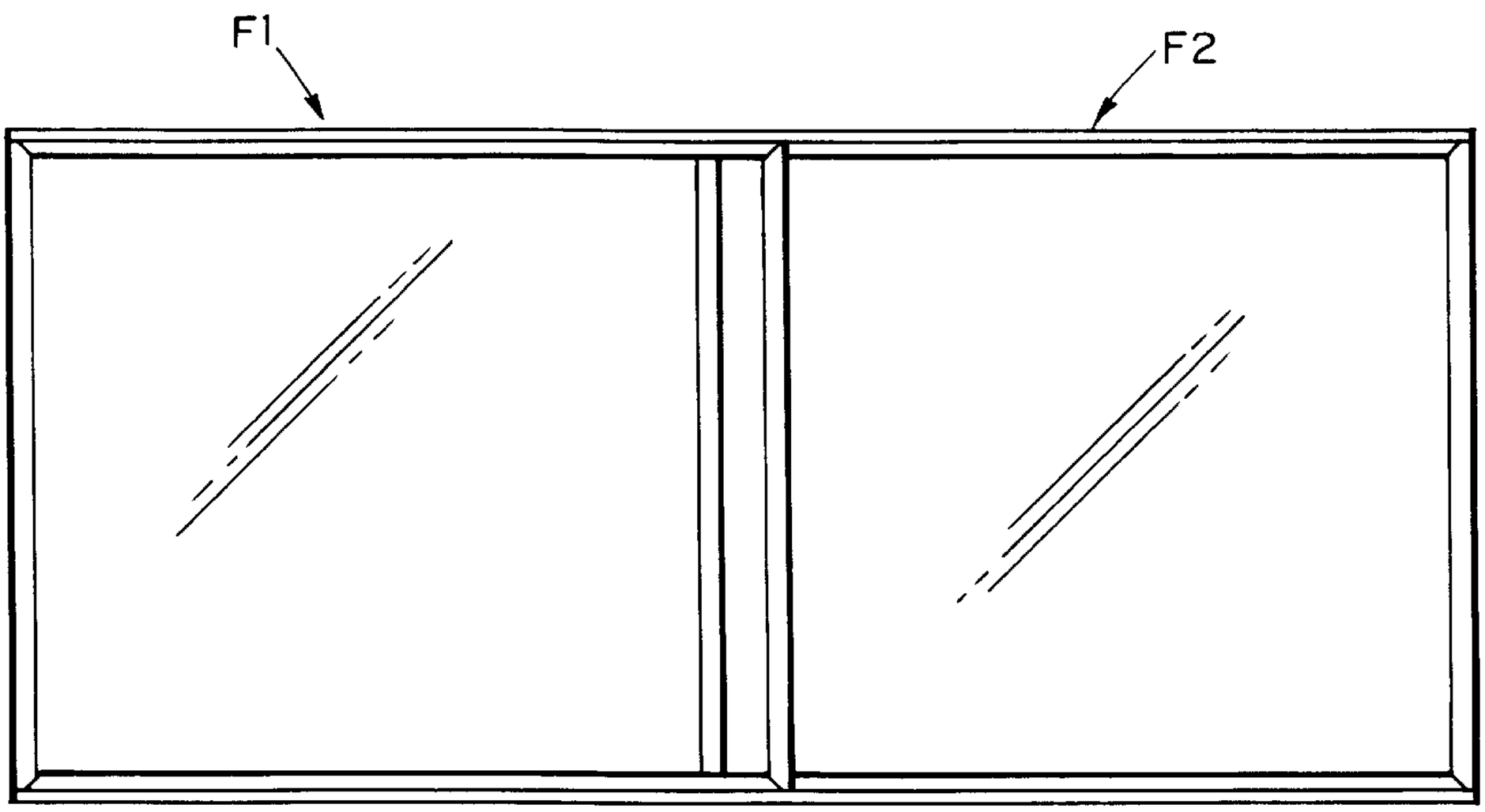

FIG. 10B

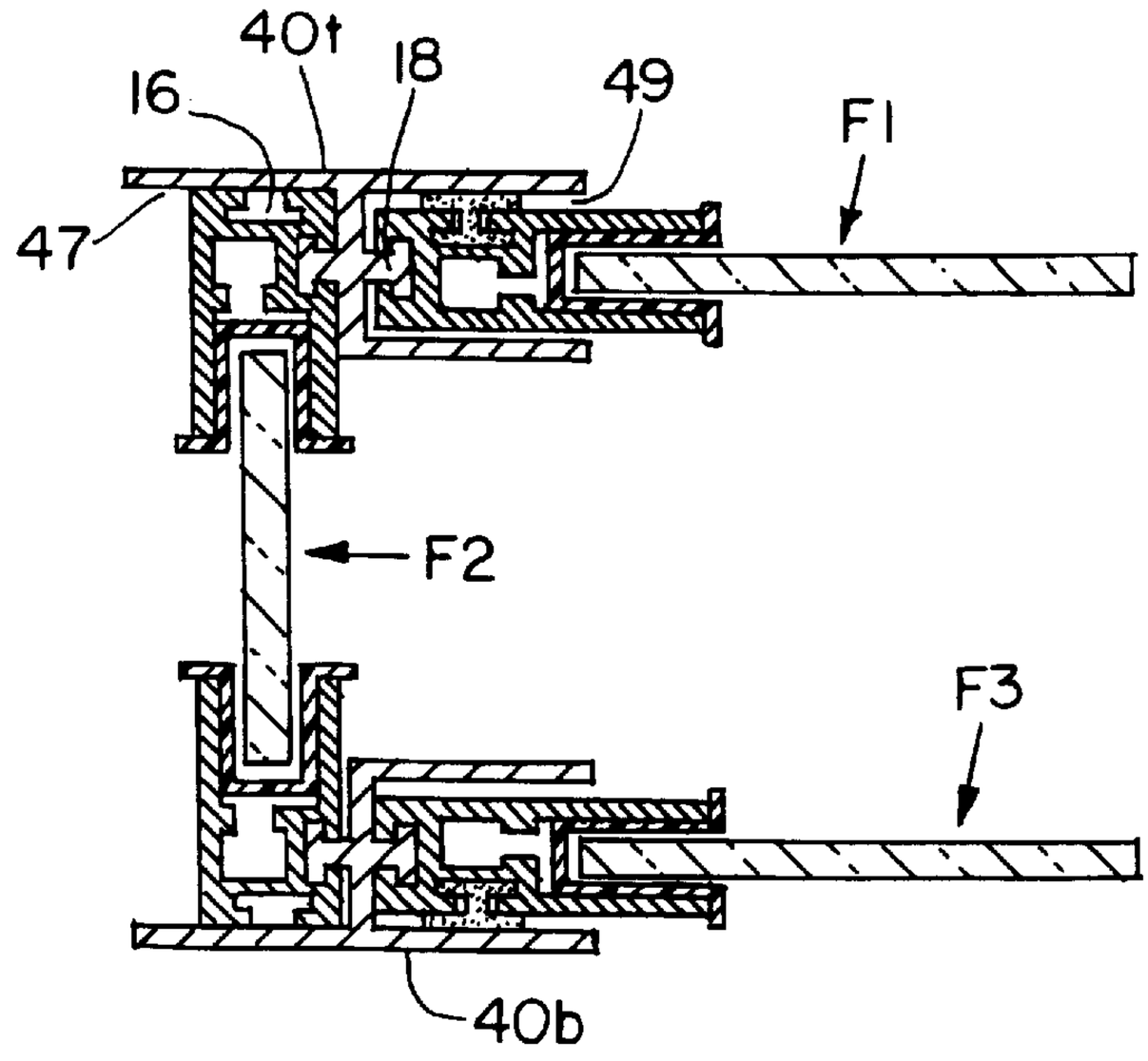

FIG. 11A

FIG. 11B

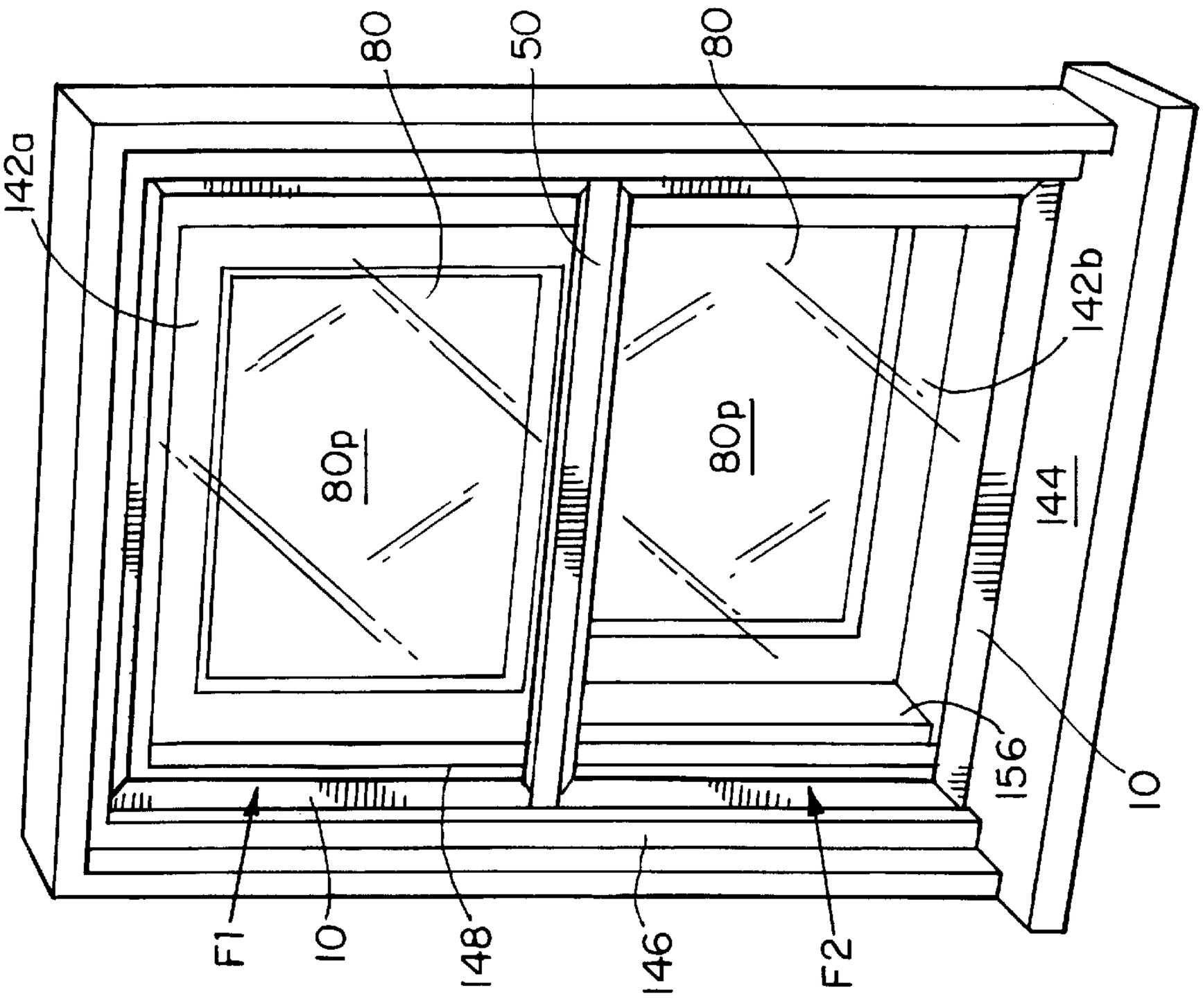
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FIG. 13

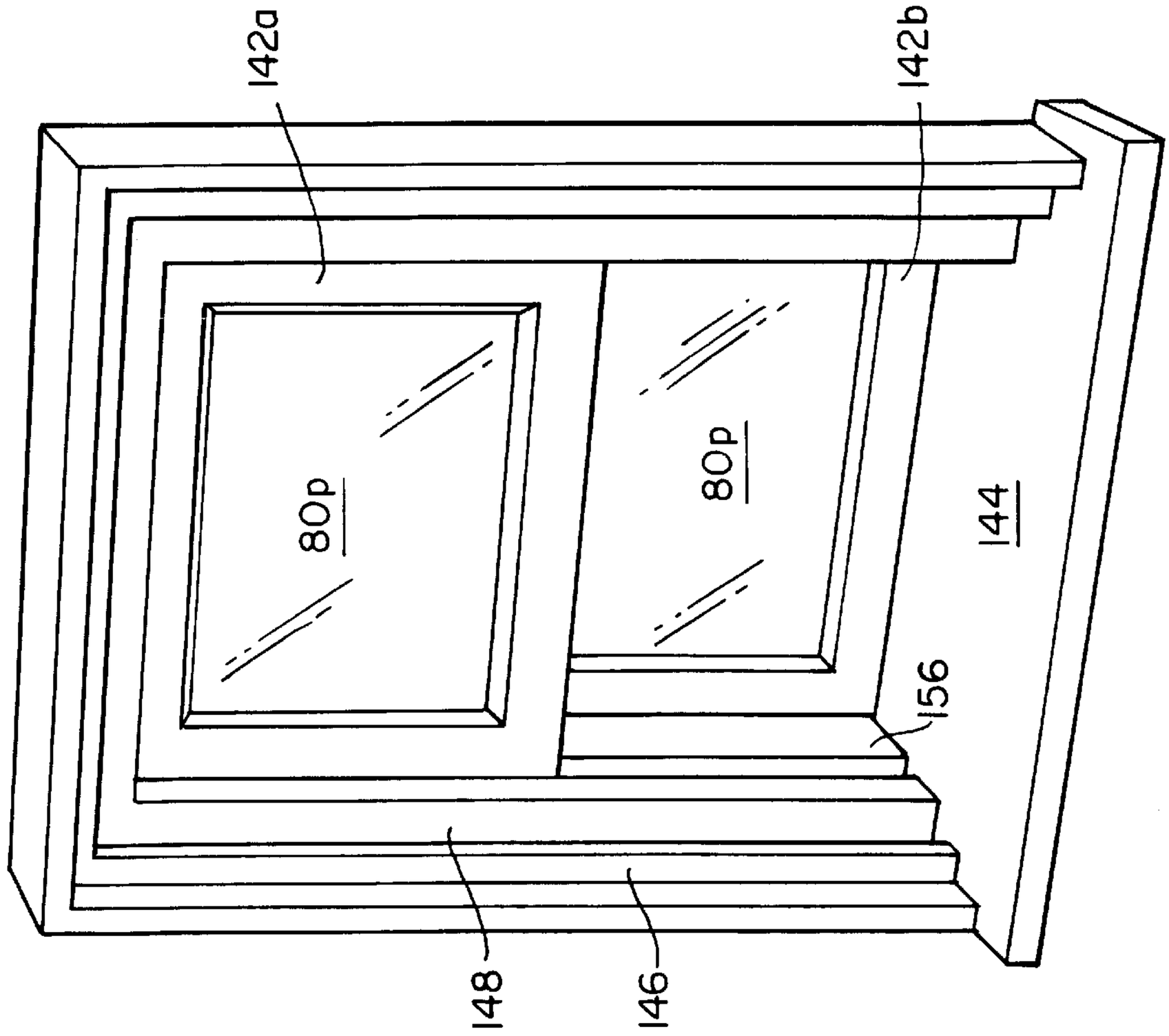
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FIG. 12

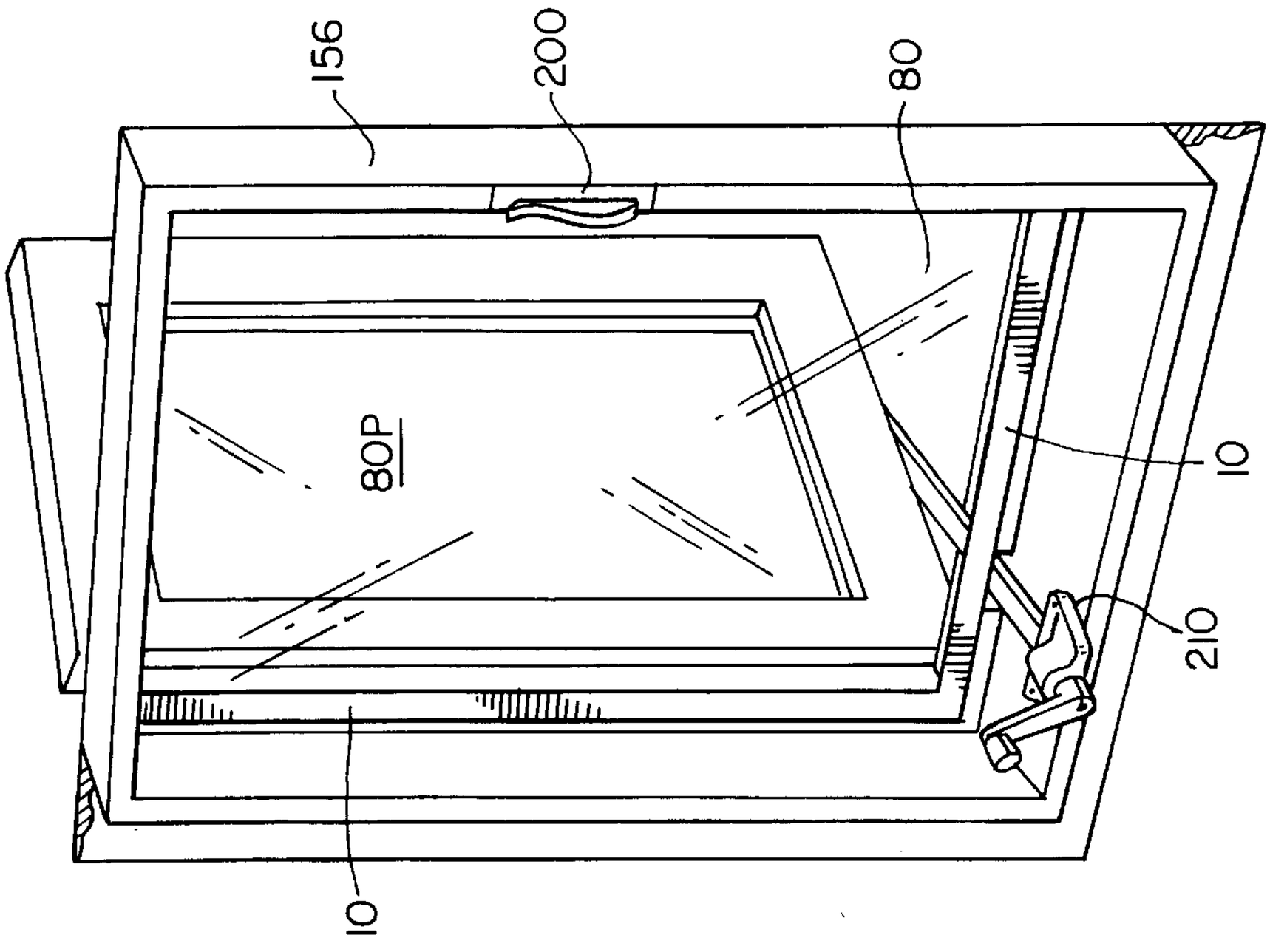

FIG. 15

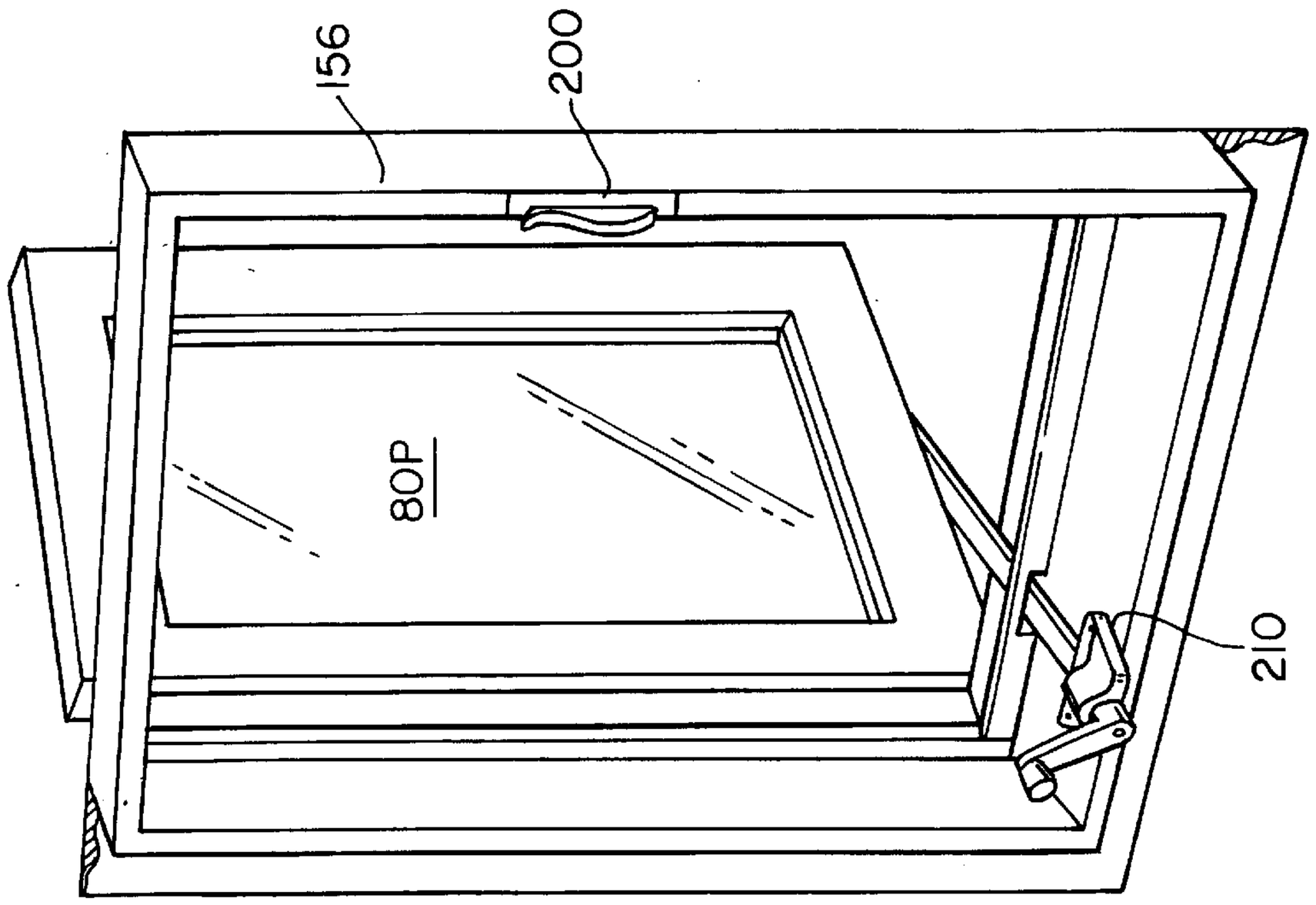

FIG. 14

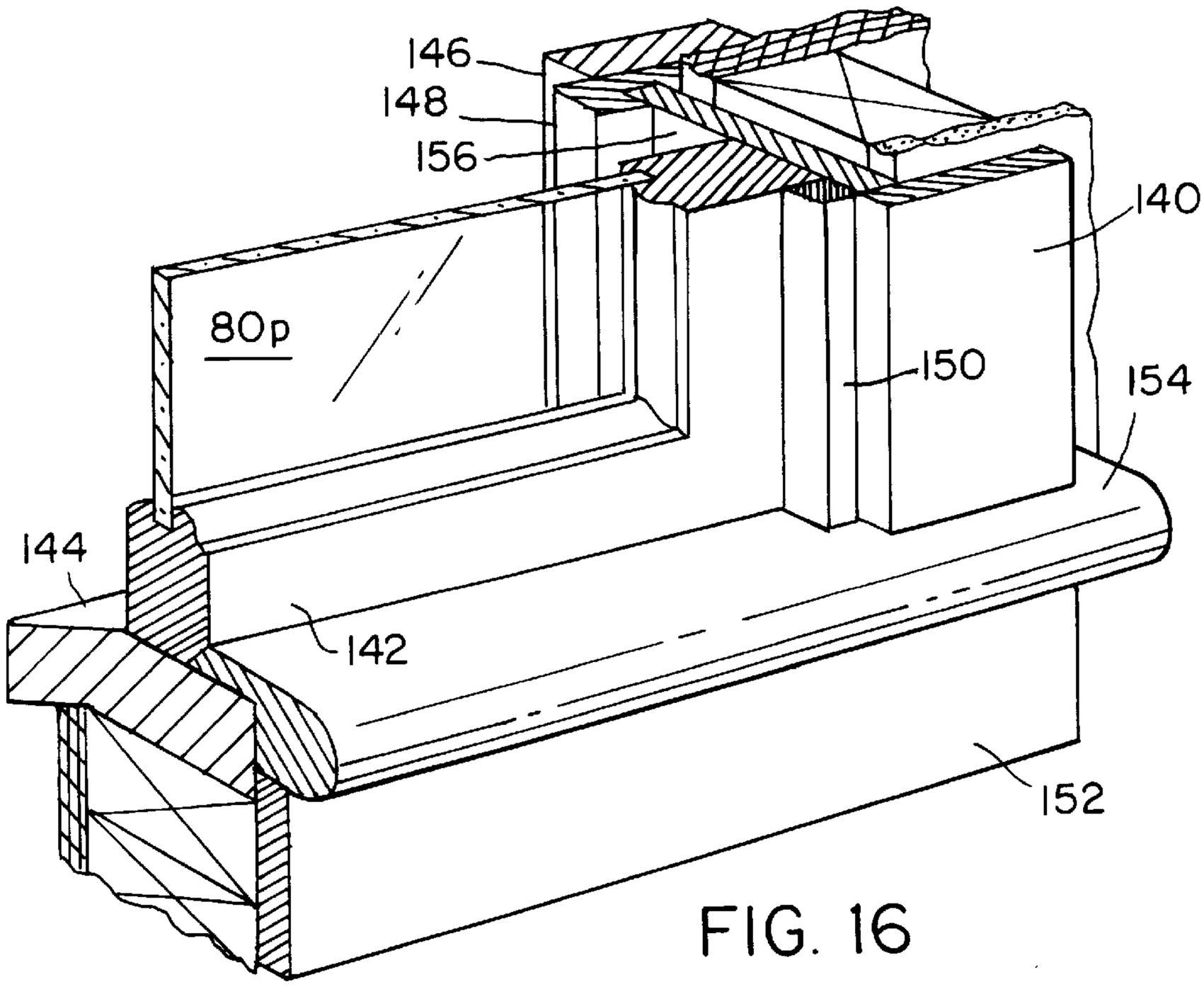
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FIG. 16

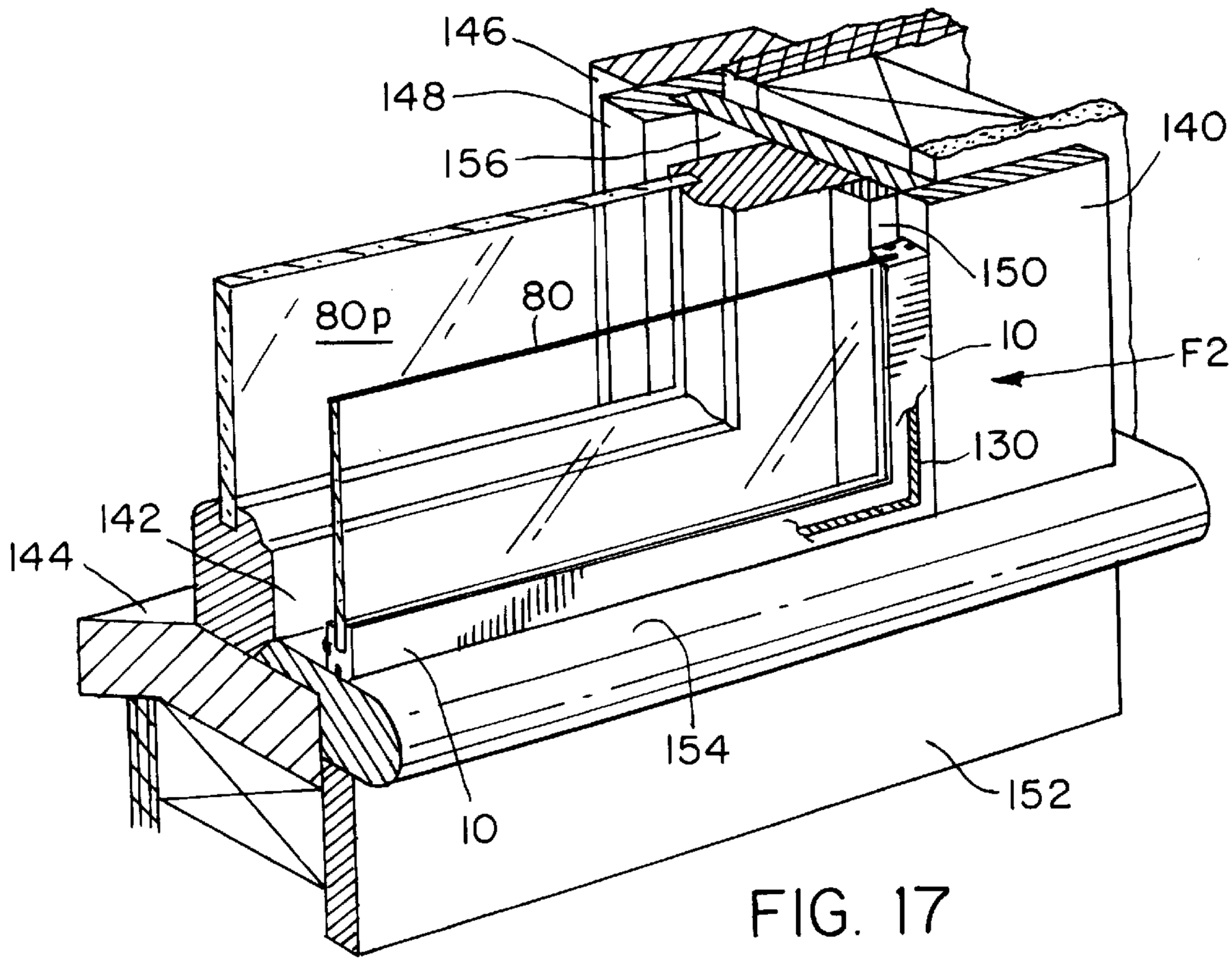
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FIG. 17

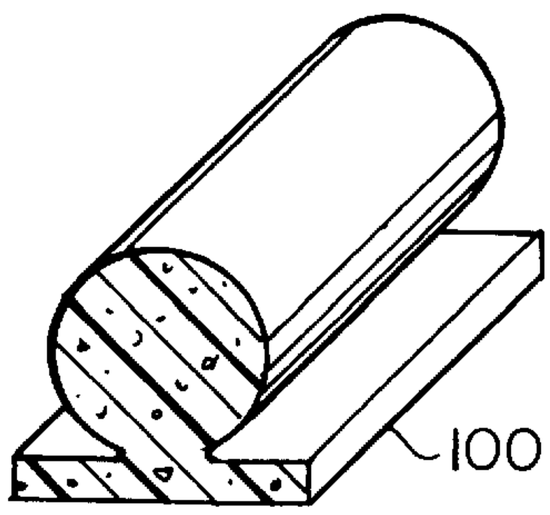

FIG. 18

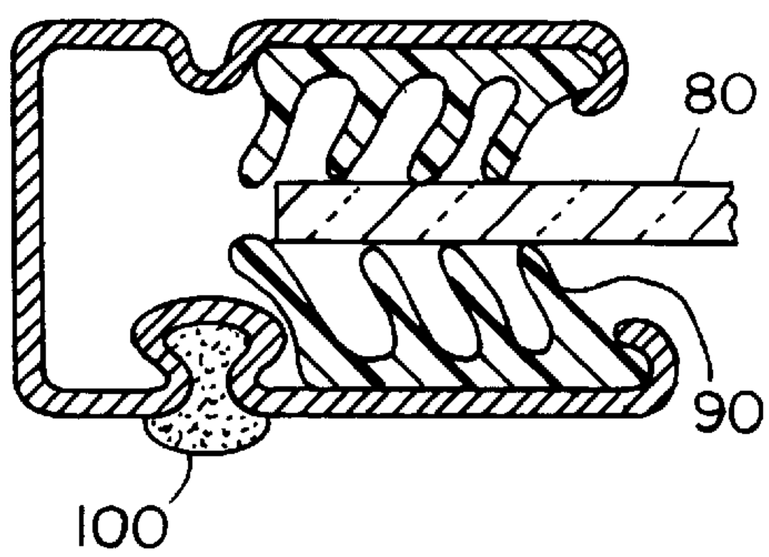

FIG. 19 Prior Art

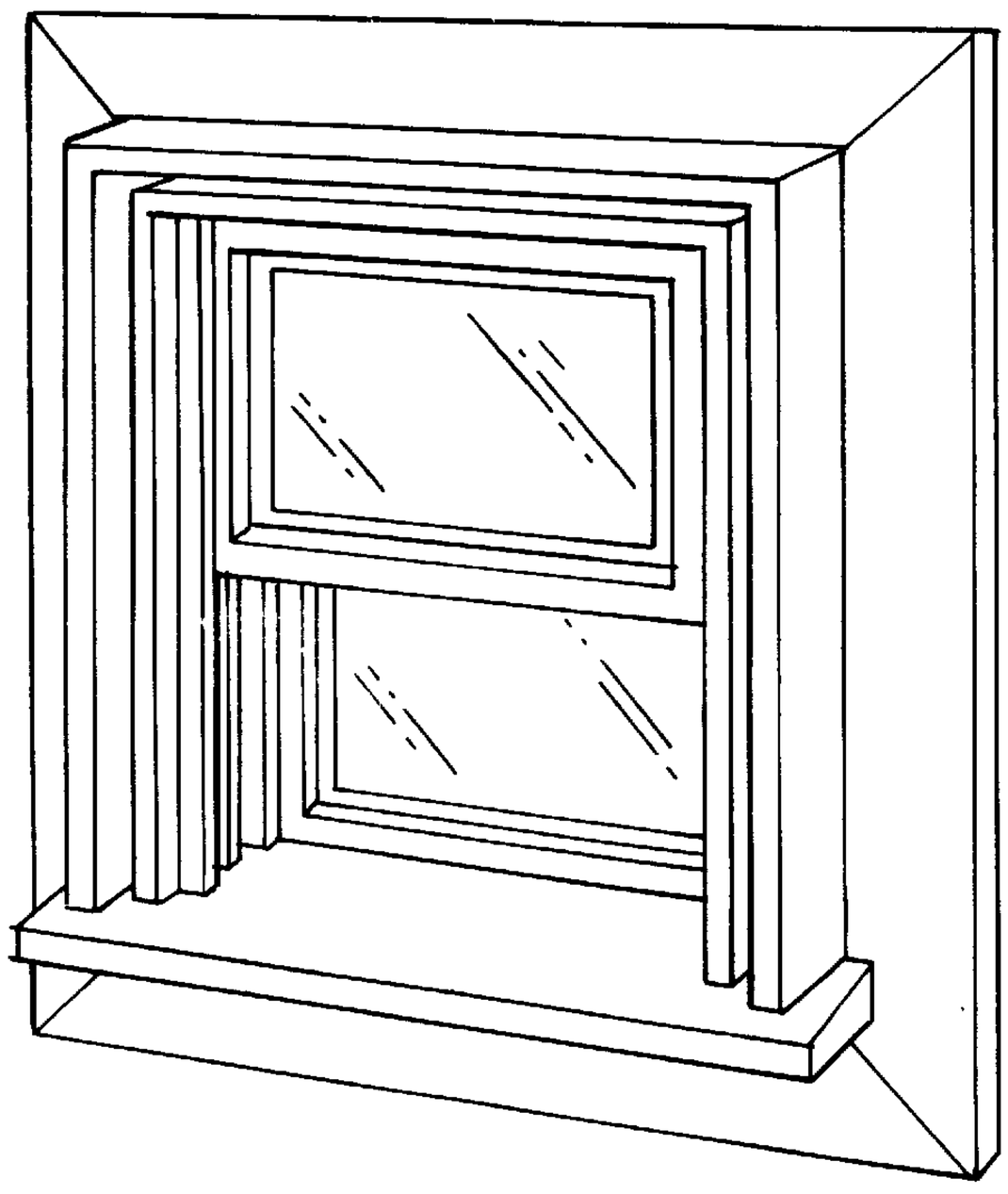

FIG. 20

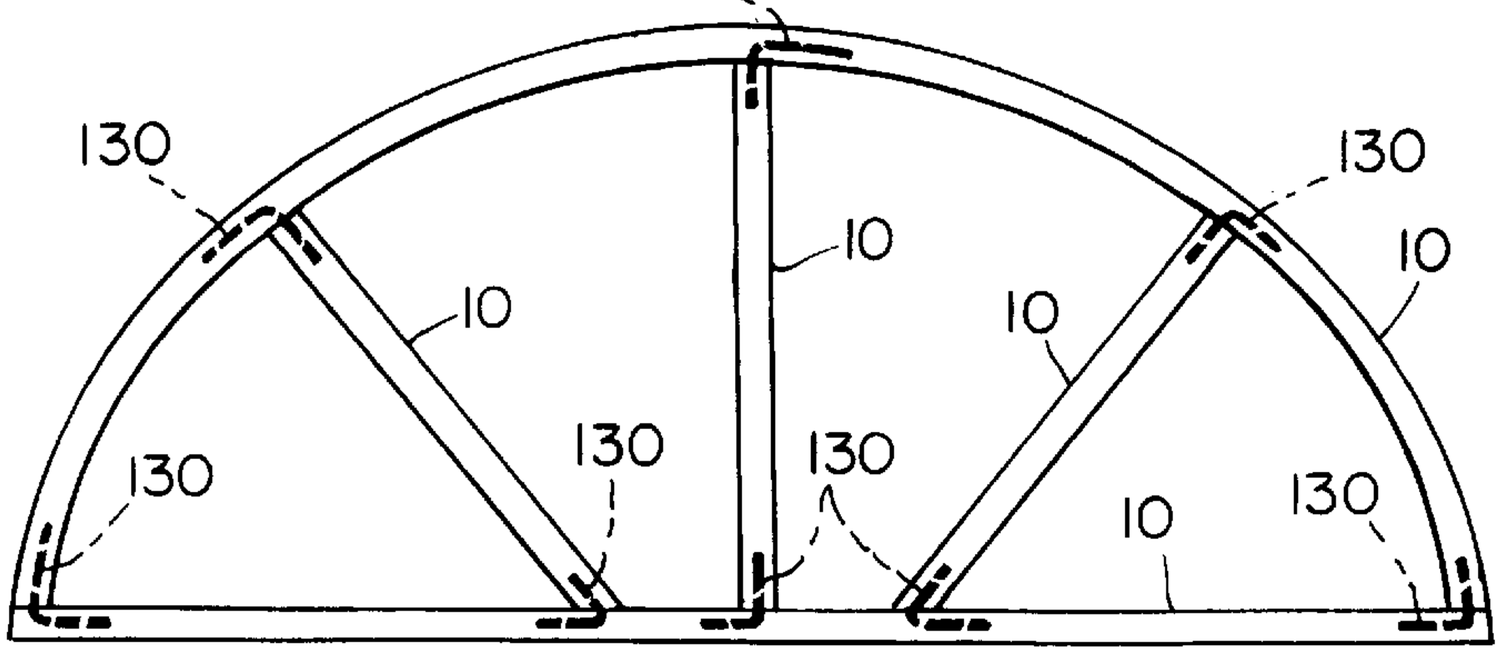

FIG. 21

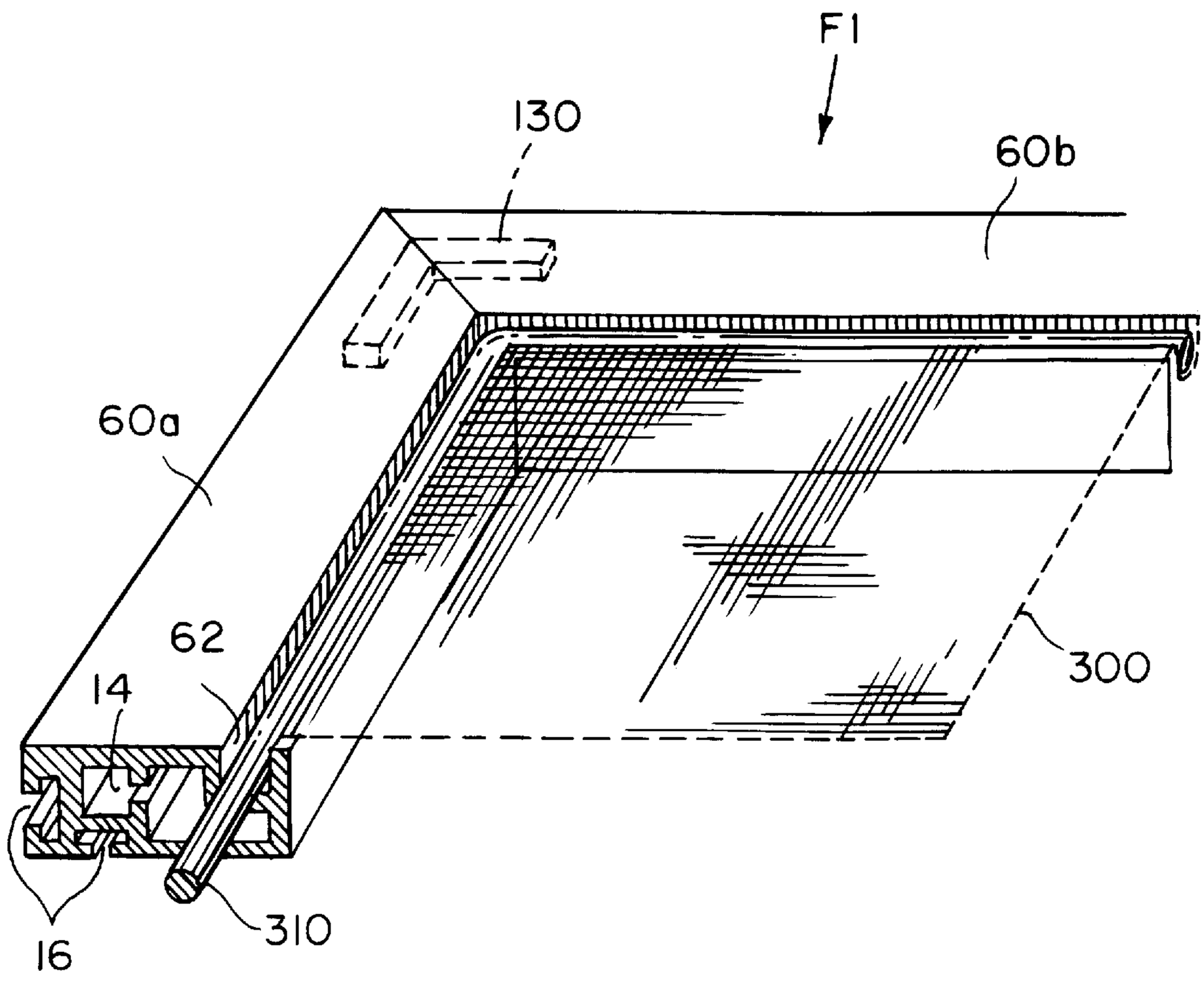

FIG. 22

MODULAR GLAZING SYSTEM

BACKGROUND OF THE INVENTION

The invention relates generally to the field of windows and similar supplemental or primary glazing systems designed to form and insulate windows and more particularly to a modular system for constructing glazing panels.

Manufacturers of glazing systems such as windows for homes and offices face the basic problems of heat transfer and air infiltration in attempting to insulate the buildings from heat or cold. While a number of advances have been made in minimizing heat transfer, such as treating glass with low emissivity coatings, or using more than one pane of glass, air still infiltrates around window casings and jambs where moving parts allow gaps and hence, convection to occur. Double-hung windows, casement windows, sliding windows and doors, all include moving parts through which air can infiltrate.

Double-hung windows with an upper and lower sash, for example, will have air gaps that occur along the casings and jambs, or wherever two surfaces slide against each other. To decrease air infiltration through such gaps, weatherstripping of some type is often employed, but usually its effectiveness diminishes over time. Wool-pile weatherstripping, for example, is worn away with repeated opening and closing of the window. Compression-fit foam stripping cannot be used where sliding movement is needed. In some windows, metal strips may be used to provide spring compression for movement, but metal is a poor thermal insulator.

Another approach to improving the energy efficiency of glazing systems is the use of exterior storm windows. Double-hung storm windows for example, can be nailed or screwed onto the exterior of a building, around a double hung primary window. However, these, too, can be draft prone, since they also have moving parts, through which air can infiltrate. Furthermore, many apartment complexes, condominiums, and historic areas have covenants or laws prohibiting changing the exterior appearance of the building. Since most conventional storm windows do alter the exterior appearance, they are unsuitable for many buildings.

Custom exterior storm windows have the same problems, simply because their construction and installation will still result in moving parts through which air can infiltrate, and their installation may render them inappropriate in appearance, too.

Interior storm windows have also been used to attempt to solve this problem. If they are not fixed, (either in whole or in part) but permit movement, the same difficulties occur as with exterior windows. Most fixed interior storm windows that are permanently installed do not permit the opening and closing of the windows. Fixed interior storm windows that are removable are usually installed with some form of fastener, such as screws or bolts, and may be unsightly.

Most storm windows or supplemental glazing systems designed for insulation purposes require some sort of fasteners, such as nails, screws, bolts, or even magnets to hold them in place. "Standard size" windows come with super wide flanges to allow for variance in window sizes and still permit fasteners to be used. (See FIG. **20**.) Fasteners often add to the cost of the system and may also make it unsightly to use on historic homes or buildings. Depending on the fastener used, installation expense can be increased. For example, if screws or bolts are used with an exterior storm window, it may take several hours to install or remove such a window.

For new construction, it may be more cost effective, in the near term, to use better insulated primary window systems

and forego the use of supplemental glazing systems, such as exterior or interior storm windows. Even using low emissivity coatings and double, triple, or multiple pane glass, however, primary windows that open still have the same problems, over time, with air infiltration as those outlined above. This results in drafts and reduced energy efficiency even in newer construction.

For existing homes, or historic homes or buildings, the costs of replacement primary windows may be prohibitive. If the windows in such a building measure fewer than 99 united inches, the owner might be able to use prefabricated, "off the shelf" exterior storm windows sold in home improvement centers. However, most existing windows are larger in dimension and require custom storm windows. Most existing windows are also likely to be irregular in their dimensions, requiring custom measuring and fitting of custom storm windows. Glazing contractors usually make these using a universal C-sash extrusion fitted to the dimensions of the particular window. This extrusion is a U or C shaped metal that can be cut and formed to fit various window sizes (see FIG. **19**.) This is an extremely thin, roll formed aluminum extrusion, with glued in place wool pile weatherstripping, which cannot be replaced, and a glued in place gasket which cannot be changed to allow any glazing options other than 1/16 inch or 1/8 inch glazing. It can only be used for stationary panels, and has relatively poor rigidity. In short, its applications are limited.

One variation of this approach is to construct a custom interior storm window that is removable, by fastening a top and two side channels to the window casing with screws and then using leaf springs to removably fit a panel of glazing into place. While this approach may solve air infiltration problems, it requires fasteners, and may also alter the appearance of the primary window.

In existing buildings, when wood sashes are replaced with replacement windows of vinyl, wood, or aluminum, existing storm and primary windows are both removed. After the replacement primary windows are installed, usually no new or old storm windows are installed because the replacement windows supposedly do not require them. While this may be true initially, as the replacement primary windows age, their weatherstripping deteriorates with the movement of the parts. Since this weatherstripping is likely to be glued in, it cannot be replaced. This allows gaps to occur, through which drafts enter the building.

The cost of a typical custom exterior storm window with wool-pile weatherstripping and screw or bolt fasteners is typically about $200, installed, for a normal 36×58 inch size double-hung window. To keep costs down, some manufacturers offer "off the shelf" standard size storm windows sometimes using vinyl framing instead of aluminum. Vinyl is less expensive and can also be produced in colors, if desired. However, vinyl is not as rigid and therefore, may not be as suited for all forms of glazing as aluminum. To keep costs down, most suppliers of storm windows, whether custom or off the shelf or vinyl or aluminum, do not offer a large number of color or paint options.

Since most exterior storm windows are installed with fasteners, caulking is desirable to minimize air infiltration in areas between the fasteners. Although paintable caulking is now available, once such a system has been installed and painted, removing it to repaint it requires removing the caulking and redoing it as well. This adds to the cost.

For existing houses and buildings, where historic district codes or condominium bylaws impose certain aesthetic requirements, the inability to provide unobtrusive glazing

systems in a large variety of economic color options becomes another problem.

It is an object of the present invention to provide a glazing system that reduces or eliminates unwanted air infiltration and energy loss in windows or storm windows having moving parts.

It is another object of the present invention to provide a glazing system that is more cost effective than conventional standard or custom storm windows.

Still another object of the present invention is providing a glazing system that is simple to install and remove.

It is yet another object of the present invention to provide a glazing system that can be configured in a number of different ways.

Still another object of the present invention is providing a glazing system that is unobtrusive in appearance when used as a supplemental glazing system.

A further object of the present invention is providing a glazing system that can be painted in one or more of a variety of colors without adding undue expense.

SUMMARY OF THE INVENTION

These and other objects are achieved by a modular glazing system having several fundamental members, each member having one or more keyways or keys that permit the members to be connected together and interlocked. In a preferred embodiment, there are four basic shapes: a base longitudinal member, an expander A, an expander B and a screen sash member. The base longitudinal member has a glazing channel, through which a sheet of glazing material can be inserted. The glazing channel in a preferred embodiment is wide enough to permit various marine glazing gaskets to be used to hold one or more sheets of glazing material of varying thicknesses in place. Along one side wall of the base longitudinal member is a keyway shaped indentation formed to interlock with a key from another piece. At right angles to the first keyway in the base longitudinal member, and disposed along a bottom wall of the base longitudinal member is another keyway, similarly shaped. The base longitudinal member also has an inner aperture through which an L-shaped connector can be inserted to form corners.

An expander is shaped generally like the capital letter H. An expander A has two keys, one located on either side of a major surface of the middle bar of the "letter" H. An expander B has only one key, depending downwardly from a major surface of the middle bar of the "letter" H. A screen sash member has two keyway openings and a glazing channel, as well as an inner aperture for insertion of the connector to form corners. Each expander can be further modified by cutting off one or more of the "walls" of the letter H or bending them, as may be required.

A sheet of glazing material is inserted into four base longitudinal members to form a panel. Compressible weatherstripping is inserted into the keyways that form the outer edges of each of these base longitudinal members. For a double hung window, another panel is constructed with weatherstripping around it, too. Each panel is fitted into a guideway of an expander B, so that the expander B holds the two of them together. In a preferred embodiment the top panel is interlocked into another expander B at its top extremity and interlocked into the first expander B at its lower extremity. The second panel slides in place under the first expander B. The entire assembly can then be compression or friction fit against the casings of a double hung window.

This compression or friction fitting also permits the windows to be removed, if desired. For example, a simple bailey latch can be used to remove a sash of a storm window constructed according to the present invention. Alternatively, a storm window sash could be provided with a built in handle to be used to pull the window out.

It is a feature of the present invention that it can be configured for a variety of window and other glazing types and sizes, whether as supplemental glazing or as primary glazing.

It is another feature of the present invention that it is less time consuming to install and remove than conventional systems and thus is more cost effective. In a preferred embodiment it uses no moving parts and no fasteners. Conventional custom storm windows may take 2–3 hours to make and install. Storm windows constructed according to the present invention can be made and installed in about 15 minutes.

It is an aspect of the present invention that it can be applied to the construction of display cases, greenhouses, sliding windows and doors, office panels, marine glazing applications and other similar uses of glazing materials.

Yet another aspect of the present invention is that it can be manufactured using existing, low-cost extrusion techniques.

Still another aspect of the present invention is that it is unobtrusive and does not detract from a building's appearance. It can be used in situations where zoning or building restrictions would not permit conventional systems for aesthetic reasons.

A further aspect of the present invention is that it permits storm windows constructed according to its methods and apparatus to be produced for the same or lower costs as conventional custom storm windows. This, together with the reduced installation times, permits a cost reduction for a typical window installation of almost 50%. If a typical custom window costs $200 installed, storm windows made according to the present invention can be installed for roughly $100 each.

Still another aspect of the present invention is that it can be used with a variety of conventional weatherstripping materials.

Yet another aspect of the present invention is that it can be scaled up or down to accommodate different types of glazing materials and applications.

Still another aspect of the present invention is that storm windows constructed according to the present invention are frameless. No additional exterior frame is needed to mount them.

It is another aspect of the present invention that storm windows made according to the present invention are easier to paint even months or years after installation. They can be popped in and out with no unscrewing or uncaulking, thus saving time and money in maintenance.

Yet another aspect of the present invention is that it can be constructed to allow a screen to be used with it on commercial doors.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1***a* is a cutaway side view of the basic members of the present invention.

FIG. **1***b* is a cutaway side view of a key of a basic member of the present invention.

FIG. **2** is a perspective partial view of the basic members of the present invention.

FIG. **3***a* is a top cutaway view of the members used in forming the panel shown in FIG. **3***b*.

FIG. **3***b* is a front view of a single pane panel constructed according to the present invention.

FIG. **4***a* is a side cutaway view of members of the present invention used to form a panel for compression fitting.

FIG. **4***b* is front view of a panel formed for compression fitting.

FIG. **4***c* is a side cutaway view of the members of the present invention used to form a panel for permanent attachment.

FIG. **4***d* is a front view of a panel formed for permanent attachment.

FIG. **5***a* is a top cutaway view of the members of the present invention used to connect two single pane panels to form a storm window for a double hung window.

FIG. **5***b* is a front view of two single pane panels assembled as a storm window for a double hung window.

FIG. **6***a* is a top cutaway view of the members according to the present invention used to connect two single pane panels for a storm window with a pocket for storing a screen.

FIG. **6***b* is a front view of two single pane panels assembled in a storm window configuration for double hung windows, with a pocket for holding a screen.

FIG. **7** is a profile perspective view of a connector used in the present invention.

FIG. **8***a* is a top cutaway view of the members according to the present invention used to connect two single pane panels in a horizontal position.

FIG. **8***b* is a front view of two single pane panels assembled in a horizontal position together with a top cutaway view of the members used for this configuration.

FIG. **9***a* is a top cutaway view of the members according to the present invention used to form the assembly of FIG. **9***b*.

FIG. **9***b* is a front view of two single pane panels assembled in a horizontal position.

FIG. **10***a* is a side cutaway view of the members according to the present invention used to create a sliding window assembly.

FIG. **10***b* is a front view of a sliding window assembly.

FIG. **11***a* is a top cutaway view of the members according to the present invention used to create a display case configuration.

FIG. **11***b*, is a perspective view of a display case configuration.

FIG. **12** is a perspective view of a conventional double-hung window.

FIG. **13** is a perspective view of a conventional double-hung window with the present invention installed in a double-hung configuration.

FIG. **14** is a perspective view of a conventional casement window.

FIG. **15** is a perspective view of a conventional casement window with the present invention installed in a casement storm window configuration.

FIG. **16** is a cutaway perspective view of a detail of the interior of a conventional window.

FIG. **17** is a cutaway perspective view of a detail of the interior of a conventional window with the present invention installed in an interior configuration.

FIG. **18** is a perspective view of weatherstripping used in embodiments of the present invention.

FIG. **19** is a perspective view of a conventional extrusion known in the prior art.

FIG. **20** is a perspective view of conventional custom storm windows, known in the prior art.

FIG. **21** is a perspective view of an arched window with divided lights according to the present invention.

FIG. **22** is a perspective view of a screen panel formed using the screen sash member of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1**, four fundamental members used in a preferred embodiment of the present invention are shown. Base longitudinal member **10**, forms a basic building block of the system. In a preferred embodiment, it is formed of aluminum in thicknesses of 0.065 inches, using conventional aluminum extrusion techniques. As will be apparent to those skilled in the art, any material sufficiently rigid to support glazing material could be used, such as vinyl or vinyl-clad aluminum, for example. Similarly, thicknesses can be varied to meet the specific application. Base longitudinal member **10** has a glazing channel **12**, an inner aperture **14**, and two keyways **16**, one keyway **16** formed as an indentation along side wall **10***a* of base longitudinal member **10** and one keyway **16** formed as an indentation along bottom wall **10***b* of base longitudinal member **10**.

Glazing channel **12** in a preferred embodiment is designed to hold one pane of glazing material in a marine glazing gasket. However, glazing channel **12** in alternative preferred embodiments can be made wider to support two or more panes of glazing material, as desired. This permits the use of double or multi-pane glazing with low-emissivity coatings and similar thermal and UV resistance features.

Still in FIG. **1**, keyways **16** are shaped to fit around keys **18** shown in expander A **40**, and expander B **50**. Expander A **40** has two keys **18**, one on either side of a middle bar **45**. Expander B **50** has only one key **18**, shown here depending downwardly from a major surface of middle bar **55** of expander B **50**. In a preferred embodiment, keys **18** are T-shaped, with a short stem. As will be apparent to those skilled in the art, any shape or structure that will provide a sufficient interlock or engagement with other pieces or with weatherstripping or compression materials can be used. Since more than 200 conventional weatherstripping materials are available in T-slot forms measuring 0.1875 inches at the T-bar wall, the T-slot shape is used in a preferred embodiment for both keyways **16** and keys **18**.

Turning briefly to FIG. **1***a*, it can be seen that the stem **18***a* of key **18** is proportionately short, when compared to the T-bar **18***b* of the T-shaped key **18**. In a preferred embodiment, the width of stem **18***a* is slightly smaller than keyway **16**, permitting it to fit inside keyway **16**. Similarly, keyway **16** has an outer opening shaped to permit either a key **18** to fit inside it, or weatherstripping in standard 0.1875 inch T-shaped configurations.

Referring now to FIG. **2**, expander A **40** is shown with two keys **18**, and having a number of "walls" **42**, **44**, **46** or **48** around a middle bar **45**. Interlock guideway **47**, the opening formed between the upper pair of walls **42** and **44**, is dimensioned to allow either a base longitudinal member **10** or a screen sash member **60** to be inserted in it and around key **18**. Similarly, interlock guideway **49**, between the lower pair of walls, **46** and **48**, is sufficiently large to permit base longitudinal member **10** or screen sash member **60** to be inserted in it and around key **18**. When a keyway **16** is inserted around a key **18** in another member, an interlock is

created between the two members. In some preferred embodiments, such as display cases, for example, this interlock may be all that is required to hold the glazing system together. Still in FIG. **2**, referring now to expander B **50**, it can be seen that only one interlock guideway **59** is formed between its lower walls **56** and **58**. A compression guideway **57** is formed between upper walls **52** and **54**. This compression guideway **57** has no key.

Turning now to FIG. **3***b*, a preferred embodiment of the present invention is shown. In this front view, a single pane of glazing material **80** is shown inserted inside four base longitudinal member **10**'s to form a panel. FIG. **3***a* shows a cutaway top view of these parts.

In FIG. **3***a*, two base longitudinal members **10** are shown at either end of a pane of glazing material **80**. The base longitudinal member **10** at the left in FIG. **3***a* is shown with marine glazing gasket **90** inserted in glazing channel **12**, holding glazing material **80** firmly in place. In a preferred embodiment, any of a number of marine glazing gaskets **90** supplied by C.R. Laurence Co., Inc., a glazing supply wholesale distributor, is used to provide optimum weather resiliency for homes or buildings that are near the sea or subject to wet-weather extremes and corrosion. As will be apparent to those skilled in the art, the present invention could also be used in boats.

Still in FIG. **3***a*, in a preferred embodiment, compressible foam bulb weatherstripping is used as weatherstripping **100**. As will be apparent to those skilled in the art, any of a number of weatherstripping products could be used for weatherstripping **100**, as long as they have a keylike shape that matches the keyway **16** of base longitudinal member **10**. Wholesale glazing material distributors list many in their catalogs.

In a preferred embodiment, the products having a t-slot shape with a wall of 0.187 inches or some similar feature that matches keyway **16** of base longitudinal member **10** are used. Alternatively, keyways **16** and keys **18** could be shaped to match a key-like feature of another weatherstripping product. The principal requirements of the weatherstripping to be used are some form of engaging shape or feature, and resilience or compressibility. Adhesive backing is optional and may not be appropriate for all applications. For example, in an another preferred embodiment, in which one panel is not intended to be removable, a weatherstripping **100** with adhesive backing could be used.

Still in FIG. **3***a*, wall **10***a* of each base longitudinal member **10** is facing towards the outside of the building. Thus, the example shown in FIG. **3***a* and FIG. **3***b* is of a panel mounted as an inside storm window. As will be apparent to those skilled in the art, the same configuration could be installed on the outside of a window, in which case walls **10***a* would face in towards the building. In either case, weatherstripping **100** must press against a solid object to form a seal and also provide compression fit.

Compressible weatherstripping **100** shown in FIG. **3***a* allows the entire panel F**1** to be inserted into a window and held in place by compression fitting. No fasteners or screws are required to insert panel F**1** formed according to the present invention. Compression fit will hold panel F**1** in place indefinitely. In one test environment, external storm windows constructed according to the present invention withstood winds of near-hurricane force levels.

Turning now to FIGS. **4***a* and **4***b*, some uses of the expanders of the present invention are shown. Panels F**1** and F**2** are formed using base longitudinal members **10**, as before, with marine glazing gasket **90** around glazing material **80**. Weatherstripping **100** is inserted in some of the keyways **16** of base longitudinal members **10** but not all of them.

As shown in FIG. **4***a*, the topmost base longitudinal member **10** of panel F**1** has weatherstripping **100** in its top wall. In this example, modified expander B **50***i* has had both of its walls removed. Still in FIG. **4***a*, it can be seen that panel F**1** has been inserted into a modified and inverted expander B **50***i*. In this example, inverted expander B **50***i* can be friction fit to the window or if the user so desires, adhesives can be used. In a preferred embodiment panel F**1** is fit into the window by compression fit, since both the top base longitudinal member **10** and the bottom base longitudinal member **10** of F**1** have weatherstripping **100** in both of their respective keyways **16**. This configuration might be used when windows have deep window sills.

In FIG. **4***c*, the topmost base longitudinal member **10** of panel F**2** does not have weatherstripping installed in the keyway **16** at the top. This allows panel F**2** to slide along keyway **18** on expander B **50**. In this configuration, expander B **50** has had one of its walls removed, (quickly referring to FIG. **1**, it can be seen that wall **52** has been removed) with upper wall **54** of expander B **50** serving as a trim feature as well as a support for panel F**1**. In this configuration, upper wall **54** of expander B**50** can be mounted to the window openings with screws or adhesives at the flange formed by wall **54** of expander B **50**. This configuration might be used when permanent installation of panel F**2** is desired. A front view of this configuration is shown in FIG. **4***d*. Note that in this front view, wall **54** of expander B **50** looks like a flange at the top of panel F**2**. This allows the window to be mounted anywhere.

In a preferred embodiment, all of the members formed of aluminum according to the present invention can be painted any of a number of colors. Since the cost of making and installing the present invention is less than that of conventional custom systems, painting becomes an economical and competitive option. This is of particular value in connection with older homes and historic buildings, where precise trim colors need to be matched exactly.

Turning now to FIGS. **5***a* and **5***b*, another configuration using base longitudinal member **10** and expander B **50** is shown. In this configuration, as shown in FIG. **5***a*, panel F**1** is inserted into a modified expander B **50**, which has had wall **52** removed. Key **18** of modified expander B **50** is inserted into keyway **16** in the interlock guideway of the top base longitudinal member **10**. This forms an interlock. For panel F**2**, weatherstripping **100**, inserted around each base longitudinal member **10** of panel F**2**, completes the closure of panel F**2** inside modified expander B **50** by forming a compression fit in compression guideway **57** of expander B **50** and a compression fit against a sill, **144**, of the opening to be glazed. The entire unit can be held in place by friction fit. This configuration could be used when it is desirable to remove the bottom panel.

Referring now to FIGS. **4***b* and **4***d*, in the front views shown therein, the system looks more like decorative molding than a functional unit. It can be seen that the present invention allows the user to construct glazing systems that have very low profiles.

Turning now to FIG. **5***a*, an expander B **50** is used to connect two panels. In this configuration it is an inverted expander B **50**. Expanders B **50** have only one key **18**. In this configuration, expander B **50** is inverted so that its key **18** can be fit into keyway **16** of the bottom base longitudinal member **10** of panel F**1**. Panel F**2** is removably compression

fit inside the bottom of expander B **50**. Weatherstripping **100** is inserted in all keyways **16** of panel F**2** shown here. In this example, then, panel F**2** is compression fit inside expander B **50**. This configuration is used for double hung storm windows.

Another configuration that can be formed using the present invention is shown in FIGS. **6***a* and **6***b*. This configuration is designed to be a storm window for a double hung window in which a screen panel is to be used and stored. In this configuration, as shown in FIG. **6***a*, panel F**1** is inserted into a modified, inverted expander B **50***im* which has wall **54** bent outward at a 90 degree angle from wall **56**. A second modified expander B **50***n* is attached to the first directly under wall **54**, by means of an adhesive or screws. This second expander B **50***n* has no key **18** and has walls **58** and **56** removed. It is formed to be a holding device for a screen (not shown). A screen can be held in place inside this second expander B **50** by using a screw **120** or some other fastener such as a latch to exert sufficient pressure to hold the screen inside.

Still in FIG. **6***a*, inverted modified expander B **50***im* is permanently attached to the window casing or jamb. Panel F**1** is then inserted into it, and interlocks with it. Panel F**2** is compression fit inside the inverted expander B **50***i* in the middle. Weatherstripping **100** inserted into both keyways **16** of the top base longitudinal member **10** of panel F**2** forms a compression fit inside the compression guideway **57** of inverted expander B **50***i*. The bottom base longitudinal member **10** of Panel **2** is also compression fit against a sill **144** or casing. In a preferred embodiment, the weatherstripping **100** used in this configuration does not have adhesive backing. Thus, panel F**2** can be removed and the screen stored above in expander B **50***n* can be inserted in its place and panel F**2** can be stored in expander B **50***n*.

With reference now to FIG. **7**, connector **130** of the present invention is shown. In a preferred embodiment, connector **130** is simply an L-shaped piece of zinc which is inserted through two inner apertures **14** of two respective base longitudinal members **10**, to form a mitered corner. As will be apparent to those skilled in the art, any similarly rigid, corrosion resistant form can be used to form corners for exterior storms. For interior storm windows, less emphasis may need to be placed on corrosion resistance for connector **130**. For windows that are more curvilinear or arcuate in shape, connector **130** can be bent to an appropriate radius to form a join between an arc and a base, for example, as in the case of the arched window shown in FIG. **21**.

Turning briefly to FIG. **16**, a detailed perspective cutaway view of a conventional double hung window system without any interior or exterior storm window is depicted. In this conventional system, primary glazing material **80***p* is inserted in a lower sash **142**. On the inside, the window is framed by interior side casing **140** and stop **150** along its sides and by stool cap **154** and apron **152** at its bottom. On the exterior, the sash is framed by sill **144**, blind stop **148** and exterior casing **146**. Jamb **156** provides underlying support for the interior and exterior casings. In the example shown, primary glazing material **80***p* could be single pane glass or double or triple pane glass with or without low emissivity coating.

Now turning to FIG. **17**, an interior storm window constructed according to the present invention is shown mounted inside the conventional double-hung window of FIG. **16**. A panel F**2** is shown here compression fit against interior side casing **140** and stop **150** on the side and stool cap **154** on the bottom. Base longitudinal members **10** are shown forming a corner by use of connector **130**. A second glazing material **80** is shown mounted in base longitudinal members **10**. As with the primary glazing material **80***p*, this could be single pane glass or double pane or have low emissivity coating. In one preferred embodiment single pane glass from 1/16 to 1/4 of an inch in width is used. In another preferred embodiment, having a wider glazing channel **12**, a double pane glass can be used. This is a pyrolytic low-E double strength glass that comes in argon-filled double panes. This glazing material has a low-e coating on what is referred to as the #3 surface. In this glass, the outer surface of the outside pane is surface #1, the inner surface of that pane is surface #2, the outer surface of the inside pane is #3 and the inside surface (the room-facing surface) is #4.

As will be apparent to those skilled in the art, a variety of glazing materials **80** can be used with the present invention to suit the particular application, as long as the dimensions of glazing channel **12** of base longitudinal member **10** are adjusted to meet their dimensions. Single or multi-pane glass with or without coatings can be used, as can safety glass or plastics or other materials, even the opaque materials used in office partitions may be used.

In the same way, while windows and deadlights (fixed storm windows) with angular shapes are shown, it will be apparent to those skilled in the art that the base longitudinal members **10** of the present invention can also be bent to any radius, so that round or oval or other window shapes can be accommodated. Similarly, the base longitudinal members and expanders can also be formed into divided lights, that is windows that have several smaller panes supported by muntins. In a preferred embodiment, the muntins would be formed of base longitudinal members **10** connected together with expanders **50** using keyways **16** and keys **18**. An arched window with divided lights constructed according to the present invention is shown in FIG. **21**.

Returning to FIG. **17**, in a preferred embodiment, storm windows for double hung windows can be constructed according to the present invention as interior storms or deadlights. As can be seen from FIG. **17**, such interior storms constructed according to the present invention would have unobtrusive low profiles that would be appropriately attractive for interiors.

Now turning to FIG. **8***a* a configuration of the present invention is shown that allows the construction of a series of windows side by side, forming a "wall" of windows. In this configuration, modified expanders B **50***m* are used at either end of the two panels F**1**, and F**2**. Panels F**1** and F**2** are connected in the center by an inverted expander B **50***i*. Panel F**2**, for example, is interlocked with expander B **50***i* as a result of being inserted in the opening of expander B **50***i* and around key **18** in guideway **59** of expander B **50***i*. This configuration can be used for very wide window openings over 7 feet in width, in which flush mounting is desired and possible. In the example shown in FIG. **8***b*, panels F**1** and F**2** are actually mounted within the window sill area.

FIGS. **9***a* and **9***b* show a configuration similar to that of FIG. **8**, except that expanders B **50** are reversed. This configuration can be used when flush mounting is not possible. In this example, panels F**1** and F**2**, extend 3/8 of an inch from the wall.

FIGS. **10***a* and **10***b* show a configuration that can be used to create sliding windows. FIG. **10***a* shows a side cutaway view of two panels, F**1** and F**2**, mounted in 4 expanders B **50***gn* (in which walls **52** and **54** have been removed). In this application, two expanders B **50***gn* are attached to each other at point X by adhesives (or by screws, or other fasteners), to

form a pair. For sliding windows, two such pairs are formed, one being inverted. Panel F1 is then inserted between the rearward upper and lower expanders B50*gn*, while panel F2 is inserted between the frontmost upper and low expanders B50*gn*. As will be apparent to those skilled in the art, wheels and sliders (not shown) can be used to facilitate movement of one or both panels F1 and F2.

FIGS. 11*a* and 11*b* show a configuration used to create a display case (shown in FIG. 11*b*.). In FIG. 11*a*, modified expanders A **40** are used to connect base longitudinal members **10** to form corners of the display case. Modified expander **40***t* at the top of the picture has wall **42** removed, which permits panel F1 to be inserted around key **18** in the interlock guideway **49** on one side, and panel F2 to be inserted around the other key **18** in interlock guideway **47** of expander A**40***t*. Note that in this example, no weatherstripping **100** is used, so that the keyway **16** located at the top of base longitudinal member **10** of panel F2 is empty. The interlocking of keyways **16** with each of keys **18** of modified expander **40***t* allows the two panels F1 and F2 to be interlocked securely. In the same way, panels F2 and F3 are interlocked with a modified expander A **40** *b*, which has its innermost top wall **44** removed. As seen in FIG. 11*b*, a display case open on one side has thus been created.

With reference now to FIG. **12**, a typical double hung window is shown from the exterior view. It has two "lights" or sashes, **142***a* and **142***b*, which are in movable relationship with jamb **156** and each containing primary glazing material **80***p*. The window is framed with a blind stop **148** and exterior casing **146** and sill **144**.

Now turning to FIG. **13**, the double-hung window of FIG. **12** is shown with a storm window constructed according to the present invention. This storm window W1 is compression fit against casing **146** and sill **144**. It consists of two panels, F1 and F2 which are formed from glazing material **80** contained in base longitudinal members **10**. Panels F1 and F2 are joined by an expander B **50**, in much the same way as depicted in FIGS. **5***a* and **6***a*.

FIG. **14** shows an interior view of a casement window, and FIG. **15** illustrates how the present invention can be used to install an interior storm window for this. In FIG. **14**, a casement window with primary glazing material **80***p* and having a cranking mechanism **210**, is shown in the open position, with no storm window installed.

In FIG. **15**, an interior storm according to the present invention is shown. As can be seen in FIG. **15**, a panel comprising base longitudinal members **10** and glazing material **80** has been inserted into the window against the inside casing in the space normally provided for a screen. The screen has been removed and the storm panel inserted in its place.

Returning briefly to FIG. **1**, screen sash member **60** is shown. Note that screen sash member **60** has, in addition to keyways **16** and aperture **14**, a spline groove **62** formed in one wall. In a preferred embodiment, screen sash member **60** is used to form panels of screens, in much the same way that base longitudinal member **10** is used to form panels of glazing material.

With reference now to FIG. **22**, a screen panel formed according to the present invention is shown. In this configuration, a first screen sash member **60***a* is shown connected to a second screen sash member **60***b* by connector **130**, which is inserted in aperture **14** of screen sash member **60***a* and then connected to screen sash member **60***b*, by insertion in its aperture **14**. Once a panel of such screen sash members is formed, screening **300** is placed over the panel F1. In a preferred embodiment, the screening material is usually metal or fiberglass, but other types of screening material could be used, such as cloth or mesh. As shown in FIG. **22**, screen spline **310** is then used to compression fit screening material **300** in place. Screen spline **310** is positioned over screening material **300** and pressed into spline groove **62** in each screen sash member **60**, to create the compression fit. In a preferred embodiment, screen spline **310** is a vinyl screen spline commonly available in the marketplace.

As will be apparent to those skilled in the art, screen sash member **60** can be used for screen panels for windows or doors, and can be assembled into many of the same configurations as base longitudinal member **10**. For arcuate or curved designs, a screen spline **310** that can be bent to a radius could be used. While screen sash member **60** is designed primarily for constructing screen panels, it could be used for decorative panels with cloth or tapestry or other applications where compression fitting with some type of screen spline **310** is desired.

FIG. **18** illustrates one of the various types of weatherstripping **100** that can be used with the present invention. In a preferred embodiment, Foam-tite weatherstripping from the Amesbury Group Inc. is used. This is a thermoplastic rubber weatherstripping with a temperature range from −40 degrees Fahrenheit to 160 degrees Fahrenheit (−40° C. to 71° C.), with water absorption of less than 2 percent, and cell walls that eliminate gaps, voids, and air pockets commonly found in open cell urethanes. It has excellent compression resilience and is tested to AAMA standards. It is available in densities from 0.14 to 0.30 g/cm^3, and with compression from 7 pounds per foot to 20 pounds per foot at 50% deflection. It has good UV stability and is a non-reactive inert chemical material. It has a K value rating for energy conductivity and is also recyclable. It can be supplied with transfer adhesive tapes, if desired.

It also is the case that reducing or eliminating air infiltration reduces sound infiltration as well, so that some level of soundproofing is a byproduct of the present invention. Thus, another use of the present invention might be for removable office partitions where some level of sound reduction is a requirement, too. To improve the efficiency of sound reduction, double panes of glazing material with large air spaces in between them can be used with the present invention.

Yet another use of the present invention would be in greenhouse structures, sunrooms, solariums and similar constructs. Because marine glazing is used in most preferred embodiments, poolhouse enclosures for swimming pools and health clubs might be yet another application.

As will be apparent to those skilled in the art, the present invention is applicable not only to supplemental glazing systems, such as storm windows, but can be used for primary glazing systems, for display cases, for sliding windows or doors used in service establishments and a number of other applications.

Base longitudinal members **10** and expanders A and B can be scaled up to larger dimensions, such as 1 inch thicknesses in order to support other types and thicknesses of glazing materials. Although glass is used in preferred embodiments as the glazing material, plastics, opaque foam boards and other materials could be used to construct modular panels or panels. Office divider partitions could be constructed according to the present invention using plastics or foam boards, for example.

While preferred embodiments use an aluminum alloy as the material for the extrusions, it will be apparent to those

skilled in the art that any sufficiently rigid, material that is also bendable or formable could be used, such as, for example, vinyl, vinyl-clad aluminum or other plastics or alloys. And while extrusion is used to form the members of the present invention, as will be apparent to those skilled in the art, other forms of manufacture could be used, such as molding, casting, stamping, etc., depending upon the materials used and the application.

Those skilled in the art will appreciate that the embodiments described above are illustrative only, and that other systems in the spirit of the teachings herein fall within the scope of the invention.

What is claimed is:

1. A longitudinal member for use in a modular glazing system comprising a base portion and two spaced apart walls on opposite lengthwise sides thereof extending in a direction away from the base portion, the base portion and the spaced apart walls defining a glazing channel extending lengthwise of the longitudinal member and dimensioned to hold glazing material therein, the base portion further including an interior aperture extending lengthwise within the longitudinal member and opening at an end thereof for positioning a connector therein to join the longitudinal member in endwise relationship with another longitudinal member the base portion further including a first keyway located opposite the glazing channel and centrally located between the two spaced apart walls of the glazing channel, the base portion further including a second keyway located adjacent to one of said spaced apart walls.

2. A longitudinal member for use in a modular glazing system comprising:

a base portion; and

two spaced apart walls on opposite sides of the base portion extending in a direction away from the base portion;

the base portion and the spaced apart walls defining a glazing channel extending lengthwise of the longitudinal member and dimensioned to hold glazing material therein;

the base portion of the longitudinal member including a keyway formed on an exterior surface of the base portion opposite of and centrally located between the walls of the glazing channel and extending lengthwise of the longitudinal member for receiving one of a weather stripping material and a key of an expander member.

3. The longitudinal member of claim **2** wherein the base portion of the longitudinal member also has a second keyway formed on an exterior surface thereof adjacent to the glazing channel.

4. A longitudinal member for use in a modular glazing system comprising:

a base portion; and

two spaced apart walls on opposite sides thereof extending in a direction away from the base portion;

the base portion and the spaced apart walls defining a glazing channel extending lengthwise of the longitudinal member and dimensioned to hold glazing material therein, the base portion of the longitudinal member including a first keyway formed on an exterior surface adjacent to the glazing channel and a second keyway formed on an exterior surface opposite of and centrally located between the walls of the glazing channel.

5. A longitudinal member for use in a modular glazing system comprising a base portion and two spaced apart walls on opposite lengthwise sides thereof extending in a direction away from the base portion, the base portion and the spaced apart walls defining a glazing channel extending lengthwise of the longitudinal member and dimensioned to hold glazing material therein, the base portion further including an interior aperture extending lengthwise within the longitudinal member and opening at an end thereof for positioning a connector therein to join the longitudinal member in endwise relationship with another longitudinal member, the interior aperture communicating with the glazing channel throughout the length of the longitudinal member.

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